U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-258 276

Player's Guide
The River Basin Model

Washington Environmental Research Center, D C

1973

BIBLIOGRAPHIC DATA SHEET	1. Report No.	2.	3. Recipient's Accession No. PB-258 276

4. Title and Subtitle

Player's Guide. The River Basin Model

5. Report Date
1973

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address

Washington Environmental Research Center, D. C.
Environmental Studies Div.

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

The River Basin Model places an emphasis on "River" as it leads one to believe that the model is primarily concerned with water management. The emphasis should be placed on "River Basin", and that term should be interpreted in its broadest sense as meaning a geographic area of land. Through its two major components--in this report, human interaction and computer simulation--the model represents the economic, social and governmental activity that takes place within the geographical boundaries defined by a river basin. The model is unlike most other simulation or human interaction models. It was not designed to accomplish any one specific purpose. Rather it was designed to let its users represent the major economic, social, and governmental decision-making processes which cause a regional system to function and change on a year-to-year basis.

17. Key Words and Document Analysis. 17a. Descriptors

*River basin development,	Demography,
*Regional planning,	Agriculture,
Mathematical models,	Income,
Economic development,	Farms,
Socisl effect,	Employment,
Decision making,	Statistical data,
Government,	Tables(Data),
Federal budgets,	Parks,
Maps,	Land use zoning,
	Computer programming.

17b. Identifiers/Open-Ended Terms

*Model studies.

17c. COSATI Field Group 8H, 13B, 5K, 5D

18. Availability Statement National Technical Information Service Springfield, Va. 22161	19. Security Class (This Report) UNCLASSIFIED	21. No. of Pages 301p.
	20. Security Class (This Page UNCLASSIFIED	22. Price 9.75/3.00

PB 258 276

273079

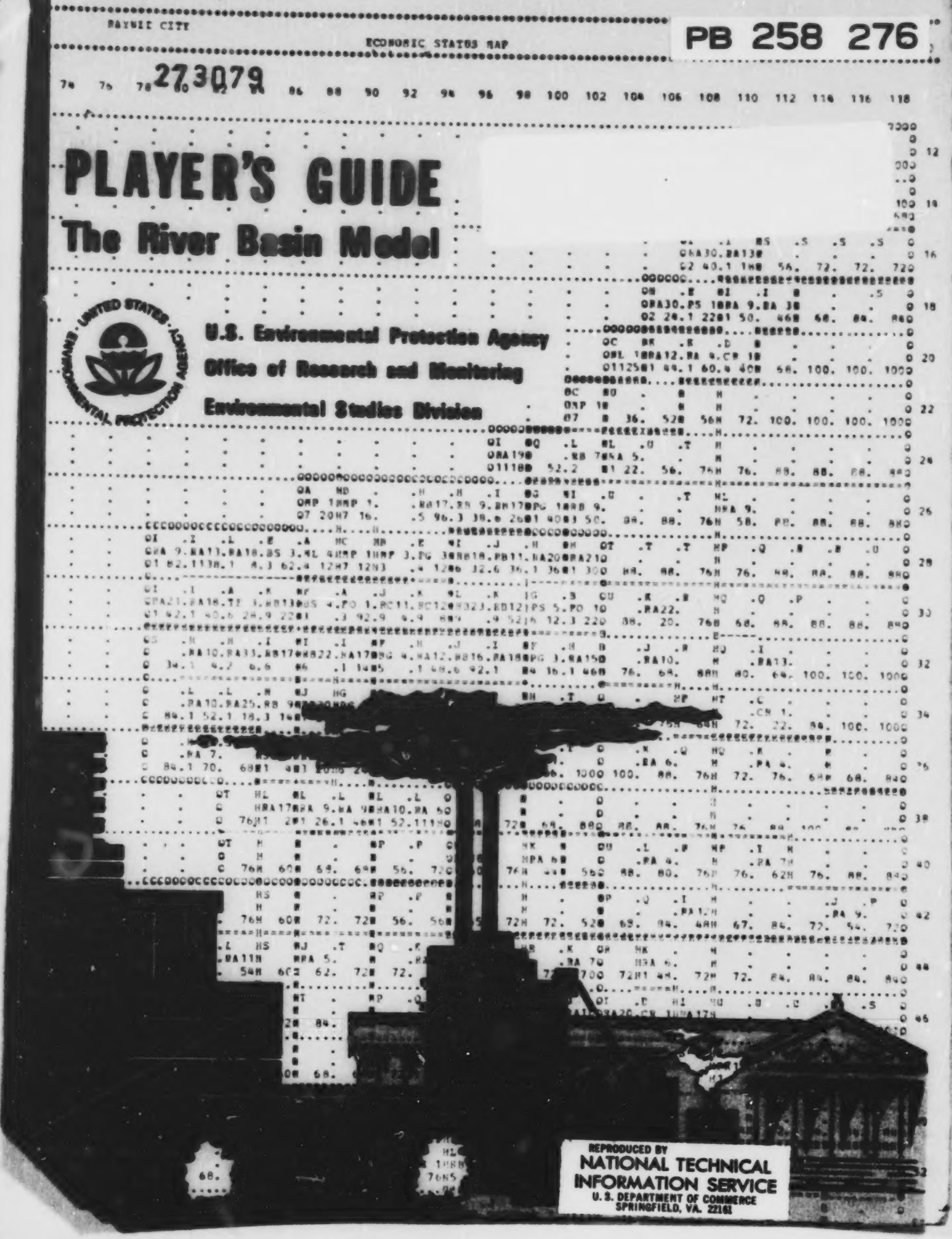
PLAYER'S GUIDE

The River Basin Model

U.S. Environmental Protection Agency

Office of Research and Monitoring

Environmental Studies Division


RAYNIE CITY
ECONOMIC STATUS MAP

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PLAYER'S GUIDE: RIVER BASIN MODEL

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Environmental Studies Division

1973

Table of Contents

I. The River Basin Model

Page

A. Introduction 1
  1. Description of the model 1
  2. Development of a data base 2
  3. Initiating a game play 4
  4. Round 0 decisions 5

B. The three sectors 6
  1. The economic sector 6
    a. Basic industry 6
    b. Commercial establishments 7
    c. Residences 7
    d. Farms 7
  2. The social sector 7
  3. The government sector 8
    a. The water component 8

C. The local system 10
  1. How a round is played (decision session) 10
  2. The function of the computer 11

D. Description of computer output 13
  1. Introduction 13
  2. Map output 15
    a. Economic status map 17
    b. Government status map 19
    c. Socio-economic distribution map 21
    d. Demographic map 22
    e. Personal goods allocation map 24
    f. Personal services allocation map 25
    g. Business commercial map 26
    h. Surface water map 27
    i. Market value map 29
    j. Assessed value map 30
    k. Farm map 32
    l. Farm assessment and market value map 33
    m. Farm runoff map 34
    n. Planning and zoning map 35
    o. Topographical restriction map 36
    p. Social decision-maker map 37

E. Summary output information 38
  1. Demographic and economic statistics 38
  2. Statistics regarding local conditions 38
  3. Transactions with the national economy 40

Page

II. General Information 42

A. Indexes and migration 42
1. Environmental indexes 43
2. Personal indexes 46
3. Dissatisfaction cutoffs 47
4. Migration detail 48
5. Migration statistics 49
6. Migration by type 49

B. Water system output 50
1. Water effluent control 50
2. River quality during surface water process 51
3. Water-user costs and consumption 52
4. Coliform and pollution index values 54

C. Employment output 55
1. The full-time employment and transportation processes 55
2. The full-time employment and transportation output 57
3. The part-time employment process 58
4. The part-time employment output 60
5. Employment summary 60
6. Employment centers 61

D. Commercial output 62
1. The commercial allocation process 62
2. Terminal allocation output 67
3. The terminal allocation map 67

III. The Social Sector 68

A. Introduction 68
1. Dollar value of time 69
2. Detailed output 70
3. Time allocation 73
4. Boycott status output 74

B. Summary information for the social sector 75
1. Social control summary totals 75
2. Social control summary 75
3. Quality of life index graph 77

C. Social sector decisions 78
1. Summary of decisions 78
2. Input format 81
3. Input explanation form 82
4. Social sector sample decisions 83
5. The vote procedure 85
6. Vote input explanation form 86

D. Social sector strategies 87
1. Gaining a perspective of the model 87
2. Establishing a joint effort 87
3. The art and science of negotiation 88
4. Decisions: general to specific 89
5. The exercise of power 90

E. Master tables 92

Page

IV. The economic sector 97

- A. Introduction 97
  - 1. Detailed output 98
  - 2. Financial summary 98
  - 3. Loan statement 100
  - 4. Land summary 101
  - 5. New construction table 102
  - 6. Economic boycott 102
  - 7. Residence detail 103
  - 8. Basic industry detailed output 109
  - 9. Commercial establishment detail 115
  - 10. Farm output 120
- B. Summary information for the economic sector 121
  - 1. Number of levels of economic activity owned by teams 121
  - 2. Economic control summary 121
- C. Economic sector decisions 123
  - 1. Summary of possible decisions 123
  - 2. Input explanation form 125
  - 3. Sample decisions 127
  - 4. Decisions specific to a team 127
  - 5. Decisions specific to a business 128
  - 6. Capital decisions 129
- D. Economic sector master tables 131
  - 1. Master table for all economic teams 132
  - 2. Economic teams 133

V. The government sector 139

- A. Introduction 139
  - 1. Sector functions 140
  - 2. Administrative (non-decision) functions 140
  - 3. Government decisions 141
  - 4. Government output 143
  - 5. Government budgetary procedures 143
- B. Chairman 145
  - 1. Introduction 145
  - 2. Chairman output 145
  - 3. Chairman department finances 146
  - 4. Tax summary 147
  - 5. Financial summary 147
- C. Summary of decisions 147
  - 1. Input format 150
  - 2. Input explanation form 151
  - 3. Sample decisions 153
  - 4. Revenue decisions 154
- D. Master tables 155

Page

VI. Assessment department 158

- A. Introduction 158
  - 1. Assessment department outpu' 158
  - 2. Tabular output 159
  - 3. Map output 160
- B. Assessment department decisions 162
  - 1. Input format 164
  - 2. Input explanation form 165
  - 3. Sample assessment decisions 166
  - 4. Setting assessment ratios jurisdiction-wide 166
  - 5. Setting assessment ratios for specific parcels 167
  - 6. Order for decisions 167
  - 7. Undeveloped land 167
  - 8. Dollar assessment decisions 167
- C. Master table 168

VII. Planning and zoning department 169

- A. Introduction 169
  - 1. Planning and zoning department report 170
  - 2. Planning and zoning map 171
  - 3. Parkland usage map 172
- B. Summary of planning and zoning decisions 174
  - 1. Input format 174
  - 2. Input explanation form 175
  - 3. Sample decisions 176
- C. Master tables for planning and zoning department 178

VIII. Municipal services department 180

- A. Introduction 180
  - 1. Municipal services department output 181
  - 2. MS characteristics 182
  - 3. Contracts 183
  - 4. Municipal services department finances 184
  - 5. Undeveloped land 185
  - 6. Outstanding bonds 185
  - 7. New construction 185
  - 8. Boycotts 185
  - 9. Municipal services map 186
- B. Summary of decisions 187
  - 1. Input format 188
  - 2. Input explanation form 189
  - 3. Sample decisions for the MS department 191
  - 4. Jurisdiction-wide decisions 191
  - 5. Operational decisions for specific MS plants 192
  - 6. Capital decisions 193
- C. Master tables for municipal services department 194

Page

IX. Utility department 197

A. Introduction 197
1. Utility department output 198
2. Utility department finances 198
3. Utility department report 200
4. Utility map 202
5. Water department reports 204
6. Sampling station report: point-source quality 209
7. Municipal treatment plant map 211
8. Municipal inflow and outflow point map 214
9. Water quality map 215
10. Water usage map 217

B. Utility department decisions 219
1. Water quality officer decisions 219
2. Input format 221
3. Input explanation form 222

C. Master tables for the utility department 226

X. School department 232

A. Introduction 232
1. School department output 233
2. School department report 233
3. School facilities 234
4. Undeveloped land 234
5. Contracts 234
6. Adult education 235
7. Boycotts 236
8. New construction 236
9. School department finances 237
10. School map 238

B. School department decisions 239
1. Input format 240
2. Input explanation form 241
3. Sample decisions for the school department 243
4. Jurisdiction-wide decisions 243

C. Master tables for school department 246

XI. Highway department 248

A. Introduction 248
1. Highway department output 249
2. Highway department finances 250
3. Highway department construction table 252
4. Highway map 253

B. Summary of highway department decisions 254
1. Input format 254
2. Input explanation form 255
3. Highway department sample decisions 256
4. Jurisdiction-wide decisions 256
5. Location-specific decisions 257

C. Master Table for the highway department 258

Page

XII. Bus and rail companies 259

A. Introduction 259
1. Bus and rail company reports 260
2. Financial report 263
3. Expenditures 265
4. Employment 265
5. Rolling stock 266
6. Passengers 266
7. Routes 266

B. Summary of bus and rail company decisions 268
1. Input forms 268
2. Input explanation form 270
3. Sample bus and rail company decisions 272
4. Rail company location-specific decisions 273

C. Master sheet for bus company and rail company 274

XIII. Appendix: Edit error messages A-1

GLOSSARY OF CODES

ECONOMIC TEAMS

(Identified by single-letter codes: A, B, etc.)

INDUSTRIAL:
- HI=Heavy industry
  - FL=Furniture and Lumber
  - SG=Stone clay and glass
  - MP=Primary metals
  - MF=Fabricated metals
  - NL=Nonelectric machinery
  - EL=Electric machinery
  - TE=Transportation equipment
- LI=Light industry
  - FO=Food
  - TA=Textiles and apparel
  - PA=Paper
  - CR=Chemicals, plastics and rubber
  - NS=National service

COMMERCIAL:
- BG=Business goods
- BS=Business services
- PG=Personal goods
- PS=Personal services

RESIDENTIAL:
- RA=Single family
- RB=Garden apts. and duplex
- RC=Multiple unit and high rise

GOVERNMENT TEAMS

(Identified by specific code preceding department name)

CH=Chairman of jurisdiction
CO=Councilman
AS=Assessment and finance
SC=School
MS=Municipal services
UT=Gas, electric, water and sewer
HY=Highways
BUS=Bus company
RAIL=Mass transit agency
PZ=Planning and zoning

SOCIAL TEAMS

(Identified by double letter codes: AA, BB, etc.)

PH=High income
PM=Middle income
PL=Low income

INTRODUCTION TO THE RIVER BASIN MODEL

Description of the model

In a sense, the RIVER BASIN MODEL is a misnomer. If one places an emphasis on "River" it leads one to believe that the model is primarily concerned with water management. The emphasis should be placed on "River Basin," and that term should be interpreted in its broadest sense as meaning a geographic area of land. Through its two major components--human interaction and computer simulation--the model represents the economic, social and governmental activity that takes place within the geographical boundaries defined by a river basin.

The model is unlike most other simulation or human interaction models. It was not designed to accomplish any one specific purpose. Rather it was designed to let its users represent the major economic, social, and governmental decision-making processes which cause a regional system to function and change on a year-to-year basis. The model is not a normative or optimizing model. It will not itself generate optimal policy decisions. The model produces a thorough set of indicators and measures of the regional status at discrete points in time (the end of each year) and it is up to the user of the model to apply his own set of objective and subjective criteria to evaluate the absolute or relative quality of the environment. For example, the model will generate measures of water quality along stretches of the river, pollution dumped by various activities, local water deficiencies, poor schools, economic rates of return, housing quality, municipal services quality, social dissatisfaction, etc., and the user of the model must determine the values to be placed on these measures as policy decisions regarding the use of the regional resources.

Normally, the users of the model are assigned decision-making responsibility for businesses, population units, and government departments in a gaming format. This means that users become members of teams that are assigned control of:

Economic Assets: cash, land, manufacturing plants, outside investments, commercial activities, and/or residences.

Social Assets: population units that are designated as high income, middle income, and/or low income.

Government Assets: power of the budget, taxing and assessing authority, service responsibility, and planning and regulatory power.

The computer printouts for a year provide a detailed description of the regional area represented by the model, and the users of the model evaluate this status as individuals, as team members, and collectively to define problems, establish objectives, develop strategies, implement plans, and react to feedback from the new computer printout for the next year.

For example, population groups reside in housing, earn incomes, purchase goods and services, take part in leisure activities, utilize government and institutional services, transport themselves, and use water. Businesses purchase goods and services, hire labor, require utilities, produce output, sell output, pay taxes, invest earnings, use the transportation subsystem, use water and generate pollutants that may be treated. Government agencies receive funds, purchase necessary goods and services, hire labor, provide service and set policy. Most of the departments also compete with each other for a slice of the local budget.

In short, the entire local system is represented by the model and its users, and decisions are placed within their realistic context of having different importance to different individuals as a function of their occupation, location, resources, and personal inclinations.

Two of the strengths of the River Basin Model are that it is both very general and very flexible. It is general in that the data characteristics of the model allow a reasonably accurate statistical description of almost any regional system to be loaded. The characteristics of a particular area can be represented through the use of hypothetical data, or real data can be used as the basis for developing the data base. It is flexible in that it can be used by either large groups, small groups, or even individuals for educational or experimental purposes.

The model is not, however, a precise prophet. It deals with system characteristics at a level of aggregation which prevents accurate predictions. Also, most predictive models deal with large time periods of 10 to 50 years. RBM's program treats system characteristics in a constant fashion using a one year time period, allowing for the modifications of the data upon which the program acts to be determined by the players or users. In other words, other predictive models determine the data base changes and then react accordingly using long time periods, and/or deal with very specific aspects of the system. RBM, on the other hand, takes a comprehensive approach to the system and allows the players to determine the system characteristics and data changes the program will react to. Once the inputs are made by the players, RBM uses a series of allocation processes considered with statistical measures of system characteristics to allow for the demonstration and study of real world relationships, decision making problems, and the effects of hypothetical decisions on the region's growth patterns.

The steps in using the model are as follows:

Development of a data base

LOAD (*Execute Maps - Round 0*) - the LOAD program places the data base in the computer. If you execute *Maps* (which is an option at any time) you receive a printout of the data on the grid structure used by the model. At *Round 0* we have only a statistical description of the chosen area. The interactive processes of the model have not yet been initiated. In other words, the system has not yet been "brought to life," and the effects that the characteristics of the system have upon one another have not yet been defined by the model.

R.B.M. - This is the core of the model. It is the series of operating programs that calculates the effects of the system characteristics upon one another and prints the output which presents the status of the system.

Round 1 - This output presents the status of the system as a result of the data loaded to describe the original chosen region.

Decision Session - In this step a group of players makes inputs (decisions) to the model as prescribed by the decision options available to the three sectors (Social, Economic, and Government). What these inputs accomplish is to change the statistical description of the system (the data base) upon which the model program (City III) acts.

EDIT - This program reviews the decisions to make sure that the proper resources are available (it is the players' responsibility to make sure that the resources are available and to coordinate his activities with the other players). If the proper preparation has been made, the EDIT program accepts the decision and updates the data base.

R.B.M. - The model program now initiates the same set of processes, but on a modified data base created by player inputs.

Round Two - This output presents the status of the system as a result of the data loaded to describe the region and the modifications made by player inputs.

From this point, the process goes back (3) steps and repeats as many times (rounds) as the users wish.

Initiating a game play

In each use of the model, the director sets the major purpose for which the model will be employed. Usually the specific group of players he has in mind will determine his choice of the executive options, such as the starting regional configuration and any Round 0 inputs to modify this basic configuration.

Before play begins, the director may affect the simulated region by selecting the basic configuration and making changes on it. He may also affect the year-to-year outside influences on the local system by, among other things, acting as the Federal and State governments with regard to granting aid and imposing regulations. For example, the director could act as an outside government that imposes rigid water quality standards or grant financial aid for the construction of waste treatment facilities.

The model can be used to represent, at various levels of sophistication, the census year status of American regions and urban areas. There are two sample starting positions for the River Basin Model-- *TWO CITY* and *RAYWID CITY*. The data for *RAYWID CITY*, for example, was derived from 1960 census data and other sources for the Cleveland-Akron metropolitan areas.

A moderate amount of time (about six man-months) was spent collecting and loading actual data to get a starting position that represented the Cuyahoga River Basin to the extent that *RAYWID CITY* does. However, no matter how much time was spent on the data collection and fitting, the River Basin Model with its present aggregation assumptions is not able to represent the Cuyahoga River Basin closely enough to deal with all of the very detailed regional problems and their solutions.

For example, the smallest increment of industrial employment is 10,000 workers. The smallest increment of land (when the land from all six counties is included) is 40 acres. The smallest school facility is for 20,000 children from all age levels. For a good many purposes, these assumptions are too heroic. On the other hand, for a number of other purposes, these assumptions allow the model to collapse time and complexity so that the users of the model (be they professionals, laymen or students) are able to grasp the interrelatedness of decisions in the economic, social, and governmental spheres of a regional area.

As a laboratory, the model provides an opportunity for its users to practice making decisions for a simulated area before they are forced to do so in real life. This can be a service to planners who may need to be aware of the broad impacts of their decisions. This can be useful to local professionals who seldom look at their impacts on the total system. It is useful to citizens who need to see the complexity of the decision-making process.

Besides choosing the basic configuration to be played, the director can make several alterations. The following list is a sample of the executive options available to a director:

Round 0 decisions:	These decisions achieve:
Change economic team holdings.	More or less team specialization or more or less equitable starting positions among teams.
Change government service levels.	Make neighborhood attractiveness vary by altering the quality of public services.
Change local tax structures.	Shift to or away from dependence upon property, sales, and/or income taxes.
Change salaries, prices and/or rents.	Alter rates of return to economic sector or savings for social sector.

These options allow the director and/or users to alter existing data bases to represent problems of particular interest to them. The users of the model may make a wide range of private and public policy decisions. The detailed and summary computer output reveals the interactions of these decisions and the collective impact they have on the environmental quality of the represented area.

THE THREE SECTORS

The model contains three basic decision-making sectors: economic, social and government. (Figure) Every city or region contains these three sectors whose interactions cause the area to function and to either grow and prosper or stagnate and decay. Decisions made by one group ultimately affect others, and one group often works against another group to achieve its goals. For example, proposed commercial developments by an economic group in a predominantly residential area can he blocked by residents of that area.

THREE DECISION-MAKING SECTORS AND CONSTITUENT TEAMS, INCLUDING CODES

ECONOMIC TEAMS
(identified by single letter codes: A, B, C, etc.)

INDUSTRIAL DECISION-MAKER

- HI-Heavy Industry
  - FL-Furniture and Lumber
  - SG-Stone Clay and Glass
  - MP-Primary Metals
  - NL-Nonelectric Machinery
  - EL-Electric Machinery
  - TE-Transportation Equipment
- LI-Light Industry
  - FO-Food
  - TA-Textiles and Apparel
  - PA-Paper
  - CR-Chemicals, Plastics and Rubber
- NS-National Service

COMMERCIAL DECISION-MAKER

- BG-Business Goods
- BS-Business Services
- PG-Personal Goods
- PS-Personal Services

RESIDENTIAL DECISION-MAKER

- RA-Single Family
- RB-Garden Apts. and Duplex
- RC-Multiple Unit and High Rise

GOVERNMENT TEAMS
(identified by the specific code preceding the department name.)

- CH-Chairman of Jurisdiction
- CO-Councilmen
- AS-Assessment and Finance
- SC-School
- MS-Municipal Services
- UT-Gas, Electric, Water and Sewer
- HY-Highways
- BUS-Bus Company
- RAIL-Mass Transit Agency
- PZ-Planning and Zoning

SOCIAL TEAMS
(identified by double letter codes: AA, BB, CC, etc.)

- PH-High Income
- PM-Middle Income
- PL-Low Income

The Economic Sector

Economic decision-makers are those businessmen who operate industrial, commercial, residential and farm establishments. Upon receiving output at the beginning of the round, economic decision-makers review their economic status and make decisions for the present round. The various economic activities in the model have the following characteristics:

Basic Industry

Heavy Industry, Light Industry and National Services spend money for business goods and business services, utilities, a labor force, transportation, and taxes. In order to produce basic industry output which is then sold to the national markets at prices determined by national business conditions (the computer), owners of basic industries can make a wide variety of decisions. These decisions include purchasing land, changing salaries or maintenance levels, boycotting business goods and business services establishments, acquiring loans, building new businesses, upgrading existing businesses, demolishing old ones, and treating effluents that are dumped into the local water system.

The basic industry of the economy can be further subdivided into the following categories:

Heavy Industry (Furniture and lumber, stone, clay and glass, primary metals, fabricated metals, non-electrical machinery, electrical machinery, and transportation equipment).

Light Industry (Food, textile apparel and leather, paper and chemicals, plastics and rubber).

Commercial Establishments

Business goods (BG) and business services (BS), personal goods (PG) and personal services (PS) spend money on many of the same items as basic industry in order to maintain a level of service capacity. This service capacity is consumed or partially consumed by local customers which include: the industrial sector, other commercial establishments and the population units (PI's) who live in the city. Owners of the commercial establishments may make most of the decisions that owners of basic industries make in addition to setting prices for their products.

Residences

Single-family (RA), townhouse (RB), and highrise (RC) residence units spend money on personal goods and personal services, utilities, and taxes, and earn income based on rent charged and the number and type of occupants residing in their housing units. Owners of residences may make the same types of decisions made by owners of basic industry in addition to setting the rent paid by their tenant

Farms

Farm owners make very few decisions aside from how their land will be utilized and what level of fertilizer use they will employ.

The Social Sector

Decision-makers in the social sector represent the citizens who live and work in the simulated area. People are represented in terms of population units (PI's). Each population unit represents fixed numbers of people (500). Population units are divided into three socio-economic groups: high income (PH), middle income (PM) and low income (PL). Because each class possesses its own expectations and behavioral patterns, each will have different preferences for residence, job, and schooling, etc. Social decision-makers can vote on behalf of the PI's which they represent. Voting power is dependent upon the number of population units controlled, the number of registered voters in each, and their socio-economic class. Social decision-makers can also direct the population units under their control to boycott places of employment or shopping locations. Social decision-makers can also allocate leisure time of their population units to be spent in any of four basic activities: extra work, adult education (public or private), politics, and recreation. The amount of time spent on each of these activities has an effect on the socio-economic status and/or the dissatisfaction index of people living within the city.

A significant part of the model centers around how PI's function within the local system during the course of each round of play. Figure 1 shows the actions of PI's as they are affected by the major operating programs.

The Government Sector

In the model, the government sector deals with the problems of education, highways, municipal services, planning, zoning, utilities, water supply and quality, and bus and rail transportation. The government sector is divided into two basic components. The first component includes elected officials: the Chairman and the Council. These officials are elected by the social decision-makers representing the people who live in each jurisdiction. The Chairman and the Council set tax rates, approve budgets, grant subsidies and appropriations, and make appointments. Appointed officials named by the Chairman are heads of these six governmental departments: Assessment (AS); Schools (SC); Municipal Services (MS); Highway (HY); Planning and Zoning (PZ); and Utilities (UT). The Bus and Rapid Rail Companies are semi-private organizations which also may be appointed by the Chairman. Players representing these departments make decisions which include allocating capital and current funds, changing salaries and maintenance levels, requesting federal-state aid, changing district boundaries, constructing or demolishing public buildings, upgrading public buildings, changing levels of service, and transferring cash between accounts.

The Water Component

The water component is a subsector that, in a sense, cuts across the other three sectors or is a part of each. For example, some of the industrial activities in the economic sector use surface water in their production process and all other economic businesses have some need for municipally supplied water. Population units in the social sector use water as a function of their income class and the type of housing they inhabit. In the government sector, the Utility Department is responsible for supplying the municipal water needs of the residents of its jurisdiction.

Each of the surface water users requires a specified quality of water and must either treat the water they intake,or purchase water from a source outside of the local system. Every water user adds some pollutants to the water it returns to the water system. If left untreated, these water discharges may lower the quality of water of the body of water into which they are dumped. Since water users and polluters are located in a geographical space, activities upstream and downstream are affected differently by the dynamically created water quality conditions.

Figure 1

How population units are affected by major operating programs

Major Program	Effect on Population
Migration	PI's move to or from the local system, find and change housing within the local system.
Water system	Poor water quality increases dissatisfaction and high coliform count increases health costs and time lost due to illness.
Depreciation	Housing that depreciates becomes less attractive in the migration process.
Employment	PI's are assigned to full and part time jobs that maximize net income (salary minus transportation costs). Employers seek best educated workers.
Transportation	PI's travel to work or shop by the mode and route that minimizes total costs (dollar plus time).
School allocation	Students of PI's are assigned to public or private schools based upon the quality of public schools.
Park allocation	PI's are assigned to parks within a specified distance of where they live.
Time allocation	Involuntary expenditures of leisure time are calculated as a function of the success of getting part-time jobs, public adult education and the time spent on transportation.
Shopping	PI's are assigned to stores at which the total costs are minimized (price plus transportation to the store).

The Local System

It is important to keep in mind that resources within the system are spatially related to one another. This spatial relationship is used by the model in calculating the effect that system resources have on each other. For example, a person will only spend a limited sum on transportation. Thus, in assigning people (PI's) to jobs, the model must take into account the spatial relationship of housing, employment centers, and the transportation network, among many other factors.

The particular regional configuration being used is represented on a grid map consisting of 625 squares. Each square is of equal size and represents 6.25 square miles, 2.5 miles on a side. The grid and all of the computer maps are keyed to a coordinate system. Each parcel can be identified by its coordinates. Horizontal coordinates range from 70 to 118 and vertical coordinates from 12 to 60. Intersections are identified by the odd-numbered coordinates and highways are identified by even-odd (east-west) or odd-even (north-south) coordinates. In all cases, the horizontal coordinate (i.e., the larger number) is identified first.

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18 .    .    X    .    .    .    .    .
   .    .    X    .    .    .    .    .
   +....+....✧....+....+....+....+....+
   .    .    X    .    .    .    .    .
20 .    .    X    .    .    .    .    .
   .    .    X    .    .    .    .    .
   +....+....+....+....+....+....+....+
   .    .    .    .    .    .    .    .
22 .    .    .    .    .    .    .    .
   .    .    .    .    .    .    .    .
   +....+....+....+....+....+....+....+
```

For example, on the map the shaded parcel is identified as 7014. Further, the 10-mile highway indicated by ZZZ is identified as 7217, 7417, 7617, 7817, while the five-mile highway indicated by XXX is identified as 7318, 7320. The intersection marked by 0 is located at 7317.

How a round is played (Decision Session)

In the model, a round represents a year of change in the life of the simulated area. From the standpoint of the participants, however, a round may be thought of as a decision-making cycle which starts when they receive their computer output and ends when they hand in their decision input forms for processing by the computer.

During the early part of the typical round, decision-makers will be simultaneously reviewing their computer output and attempting to organize their possible actions. Economic decision-makers, for example, will probably attempt to acquire parcels of land that look good for future development purposes. They may attempt to secure loans from local or outside sources, apply for zoning changes, request utility expansions, and lobby for increased highway access. At the same time, social decision-makers might be bargaining for higher wages, requesting improvements in local schools and municipal services, lobbying for higher water quality in the local river, and trying to promote those politicians who see things their way.

Meanwhile, the governmental decision-makers may be receiving requests from the economic and social decision-makers to lower taxes, improve schools, provide better municipal services, expand highways, build additional utilities, enlarge the park system, and improve other services. Budget officials are faced with the task of finding additional revenue to meet expanding public needs and dividing appropriations among the many local departments. Also, the government office concerned with water quality might be pressuring the polluting industries to treat their wastes or face regulatory action.

Toward the middle of the round, it becomes clear to many decision-makers that not all of their requests will be granted. Thus, tradeoffs and bargains must be made. Elected officials will begin to worry about staying in office. Departments must often plan to operate with less funds than they had requested. Low income representatives attempt to make their political power felt. High income representatives attempt to maintain their status. Businessmen begin to look for short-cuts to reduce their losses and increase their activity and profit-making ventures.

As the round approaches a conclusion, the participants formalize the bargains they have made, continue to fill out their decision forms, terminate the negotiations on new waste levels, new prices and new rents, carry on their boycotts and complete any other possible actions. All water-related decisions by the private and public decision-makers are completed. Treatment plants are built, industries shut down, fines levied, sampling stations constructed, etc.

When the round ends, participants campaign and carry out new elections, hold town meetings, discuss their actions, and develop new strategies while the computer performs its functions and prepares new output on the status of the simulated city.

The function of the computer

In the model, players are able to exercise a number of decision alternatives. Only some of these will be communicated to the computer, the rest will be part of the constant communication, bargaining and negotiating carried out in the game-room itself. The computer performs several major functions in the model:

First, it stores all the relevant economic, social and governmental statistics for the area; updates data when changes are made; and prints out yearly reports on the status of the local system and reports for the economic, social, and government decision-makers.

Second, the computer simulates the actions of the outside system. For example, the computer simulates: a national business cycle, the probabilities of federal-state aid and interest rates on most loans.

Third, the computer performs certain routine functions or processes that would be time-consuming if the players themselves were to perform them. For example, the computer assigns workers from population units to jobs under the assumption that workers will attempt to earn as much money as possible. Other processes include assessing all property, assigning buyers of goods and services to shop at particular commercial establishments, assigning children to public or private schools based upon the capacity and quality of the public schools, and assigning population units to residences based on their desirability. The computer also simulates the migration process which moves population units into, out of, and within the local system. It also measures the types of pollution along the river system and calculates a comprehensive water quality index.

DESCRIPTION OF COMPUTER OUTPUT

Introduction

The printed computer output provides a yearly report on the status of the simulated region and of the interactions during the previous year. There are several types of output: maps showing characteristics of the region which differ geographically, summaries which present information in condensed form; and detailed information from which the summaries are derived.

Figure 2 on the next page shows the titles of all the output sections. The output explained in this section, however, is only that output which is of general interest to all players. Output which is of particular interest to players in specific roles will be found in the chapter in this manual explaining that role. [References to the location of each piece of output and the accompanying explanation are given in the index.]

There are a few standard features of all printed output sections. Each has a title. Each also contains both the round number and the game heading (the name of the data base being used or some other heading input by the director). Where relevant, a jurisdiction number is also printed.

After a few rounds' experience with the model, a model user usually needs only the printed computer output from a round and the Master Tables and input formats contained in this manual in order to play subsequent rounds.

FIGURE 4

RIVER BASIN MODEL OUTPUT

Migration	Environmental Indexes
	Personal Indexes
	Dissatisfaction Cutoffs
	Migration Detail
	Migration Statistics
	Migration Summary
Water System	Water User Effluent Content
	River Quality During Surface Water Process
	Water User Costs and Consumption
	Coliform and Pollution Index Values
Employment	Employment Selection Information for PL Class
	Employment Selection Information for PM Class
	Employment Selection Information for PM Class
	Part-Time Work Allocation for PM Class
	Part-Time Work Allocation for PM Class
	Part-Time Work Allocation for PL Class
	Employment Summary
Commercial Allocation	
	Personal Goods Allocation Summary
	Personal Services Allocation Summary
	Business Goods Allocation Summary
	Business Services Allocation Summary
	Government Contracts
	Terminal Demand and Supply Table
	Terminal Allocation Map
Social Sector	Dollar Value of Time
	Social Decision-Maker Output
	Social Boycotts
Economic Sector	Farm Output
	Residence Output
	Basic Industry Output
	Commercial Output
	Economic Boycott Status
	Social Control Summary for Teams
	Social Control Summary Totals
	Economic Graphs for Teams
	Social Graphs for Teams
Government Detail	Assessment Report
	Water Department Reports
	Sampling Station Report:Point Source Quality
	Sampling Station Report:Ambient Quality
	Utility Department Report
	Utility Department Finances
	Municipal Services Department Report
	Municipal Services Department Finances
	Municipal Services Department Construction Table
	Planning & Zoning Department Report
	School Department Report
	School Department Finances
	School Department Construction Table
	Highway Department Finances
	Highway Department Construction Table
	Rail Company Report
	Bus Company Report
	Chairman Department Finances
	Tax Summary
	Financial Summary
Summary Statistics	Demographic and Economic Statistics
Maps	Personal Goods Allocation Map
	Personal Services Allocation Map
	Business Commercial Allocation Map
	Municipal Service Map
	School Map
	Utility Map
	Water Usage Map
	Water Quality Map
	Municipal Treatment
	Municipal Intake and Outflow Point Map
	Surface Water Map
	Farm Runoff Map
	River Basin Flood Plain Map
	Farm Map
	Farm Assessed and Market Value Map
	Market Value Map
	Assessed Value Map
	Economic Status Map
	Highway Map
	Planning and Zoning Map
	Parkland Usage Map
	Socio-Economic Distribution Map
	Demographic Map
	Social Decision-Maker Map
	Topographical Restriction Map
	Government Status Map

MAP OUTPUT

The model output includes several maps which visually represent characteristics of the simulated region. The entire simulated region is represented in each case on a single, two-page computer-printed map. A map key is printed at the bottom of each page. Map symbols appear in the three types of locations which can be specified in the model; parcels (squares), parcel edges (lines separating squares), and intersections of lines (parcel corners). Land uses and other characteristics of parcels are represented by codes within the squares. Divisions between parcels, such as roads or jurisdiction boundaries, are represented on the lines between parcels, and certain facilities such as terminals are represented at parcel corners.

All the Map Titles, and a brief description of their contents, are given below

Economic status map: economic owners, economic activities and operating levels, zoning, levels of utilities installed, amounts of undeveloped land, road types, terminal levels, jurisdiction boundaries. Page 17

Government Status map: school locations and levels, parks, municipal service locations and levels, utility plant locations and levels, road locations and types, terminal locations and levels, jurisdiction boundaries. Page 19

Socio-economic distribution map: residence types and levels, number of PI's of each class, road types, terminal levels, jurisdiction boundaries. Page 21

Demographic map: populations, residential quality indices, business value ratios, percent occupancy, road types, terminal levels, jurisdiction boundaries. Page 22

Personal goods (PG) allocation map: PG shopping location for each class and residence, PG locations. Page 24

Personal services (PS) allocation map: PS shopping location for each class and residence, PS locations. Page 25

Business commercial map: Business Goods (BG) and Business Services (BS) shopping location for each business, BG and BS locations. Page 26

Utility map: utility units served, utility units installed, utility plants, utility district boundaries, jurisdiction boundaries. Page 202

Surface water map: volumes of surface water, rates of flow, land area in water, directions of water flow, lakes. Page 27

Municipal treatment plant map: municipal water intake treatment plants and levels, municipal sewage treatment plant types and levels, utility plant locations and code numbers, directions of surface water flow, utility district boundaries, lakes. Page 211

Municipal inflow and outflow point map: municipal surface water intake points, municipal sewage outflow points, utility districts served by each, surface water qualities, directions of surface water flow, utility district boundaries, lakes. Page 214

Water quality map: economic activities and operating levels, surface water qualities, directions of surface water flow, lakes. Page 215

Economic sector water usage map: economic activities and operating levels, amounts of recycling, business effluent treatment types and levels, utility district boundaries, jurisdiction boundaries. Page 217

Municipal services map: economic activities and operating levels, municipal service units required, municipal services and their use indexes, municipal service district boundaries, jurisdiction boundaries. Page 186

School map: numbers of public school students, numbers of private school students, schools and their use indices, school district boundaries, jurisdiction boundaries. Page 238

Highway map: economic activities and operating levels, road types, terminal levels. Page 253

Planning and zoning map: zoning, park, public institutional land uses, road types, terminal levels, jurisdiction boundaries. Page 171

Parkland usage map: parks, populations served by park, park use indices, road types, terminal levels, jurisdiction boundaries. Page 172

Market value map: market values of all non-farm land, privately owned buildings and privately owned land and buildings, road types, terminal levels, jurisdiction boundaries. Page 29

Assessed value map: assessed values of non-farm privately owned land and buildings, road types, terminal levels, jurisdiction boundaries. Page 30

Farm assessed and market value map: assessed and market values of farms, amount of land in farms, road types, terminal levels, jurisdiction boundaries, lakes. Page 33

Farm map: farm owners, amount of land in farms, farm types, levels of fertilization, road types, terminal levels, jurisdiction boundaries. Page 32

Farm runoff map: where runoff from farms flows, direction of surface water flow, lakes. Page 34

River basin flood plain map: river basins, dam priorities, flood susceptibility of each parcel, direction of surface water flow, lakes, jurisdiction boundaries. Page 35

Topographical restriction map: topographically undevelopable land, road types, terminal levels, jurisdiction boundaries. Page 36

Social decision-maker map: social decision-maker controlling each class living on each residence parcel, road types, terminal levels, jurisdiction boundaries. Page 37

The following section provides a more in-depth explanation of those output maps which are of general interest, and includes illustrative samples drawn from actual game-plays. Detailed explanations and examples of the other maps can be found in those chapters describing the role to which they are most closely related, as noted on Figure 4.

Economic Status Map

This map shows the economic sector owners of all privately-owned non-farm parcels and the economic activity, if any, on each parcel. A parcel can have only one economic owner and one economic activity. Owners of farm parcels are shown on the Farm Map. The types of economic activities represented in the model are listed in the Economic Sector Master Tables.

The economic owner of a parcel owns all of the land and developments on the parcel which do not belong to the government or which are not topographically undevelopable. If the economic owner sells land to another economic decision-maker, he must sell all of the privately-owned land and buildings on the parcel to the new owner. However, an economic decision-maker can sell a portion of undeveloped land on a parcel to a government department.

The Planning and Zoning Department may zone parcels. Zoning is a restriction on economic development. Once a parcel is assigned a particular zoning code, all new economic development on the parcel must conform to the new zoning. If a parcel is unzoned, there is no restriction on what type of activity may be constructed on it. The Economic Status Map key defines what private land uses are allowed under each zoning code.

When a new economic development is constructed on a parcel, it must not only conform to the parcel's zoning; it must have sufficient utility service. Utilities are installed by the Utility Department in "levels" (1-9). Each level of economic activity requires a certain number of utility units, and each level of utility service supplies a fixed number of utility units to a parcel. (See Utility Department Master Tables, page**226**).

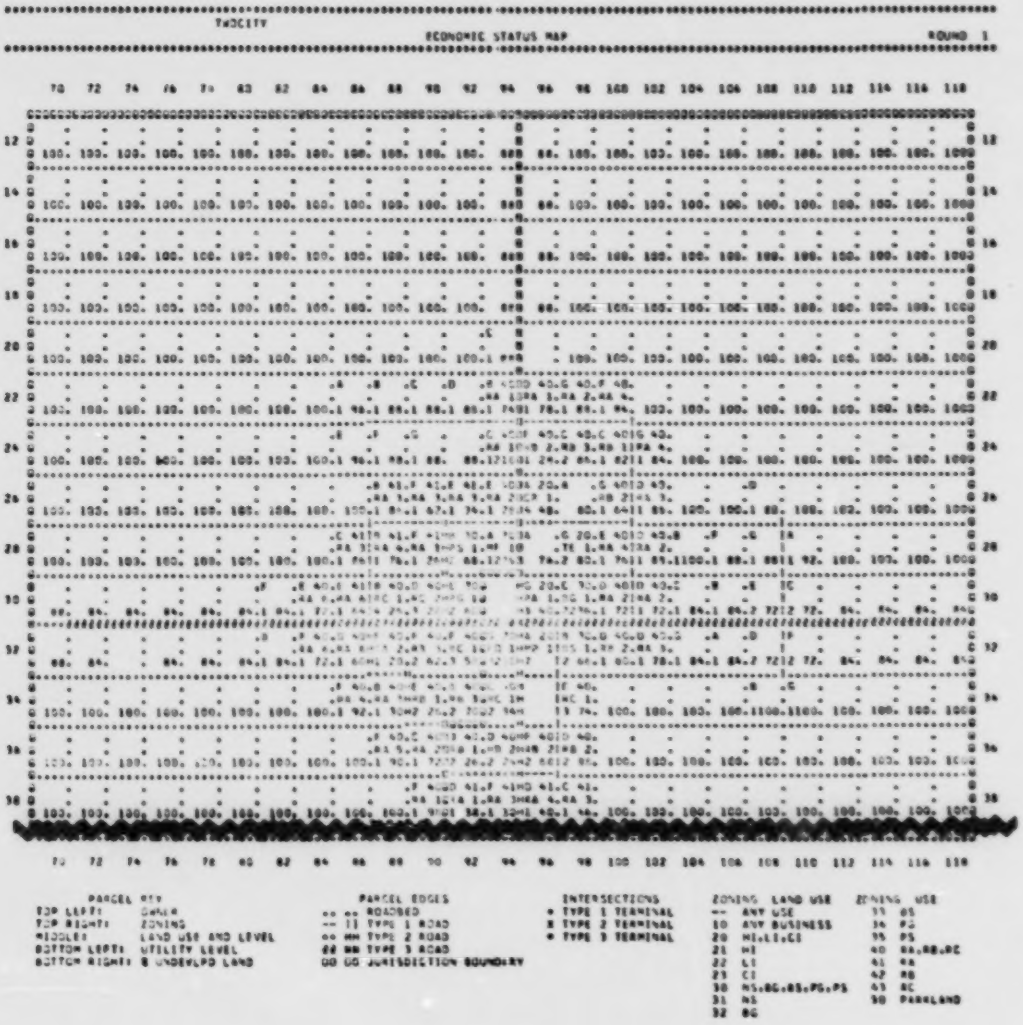
If an economic decision-maker has insufficient utility service for a proposed development, the Utility Department must install adequate utility service before the new development can be constructed.*

Economic developments also require land. Each activity, depending on its types, requires a certain amount of land for each constructed level of development. Regardless of the operating level of an activity, the land consumed is that of the constructed level, which is always greater than or equal to the operating level. (See Economic Sector Master Tables, page **131** .) The amount of privately-owned land which is not in developments is classified on this map as undeveloped. If a parcel shows no undeveloped land, no further economic development can occur there unless the owner either acquires more land from a government department owning a portion of the parcel or demolishes existing economic developments. Further development on an already developed parcel can only be done through expansion of the constructed level of the present land use since only one type of economic land use activity can occupy a parcel. An economic decision-maker can acquire land by purchasing a parcel from another economic decision-maker or by bidding on land which is owned by the Outside,(represented by the computer).

---

*There is an exception to the utility restriction on development. RA housing can be built with "private utilities", which do not require utilities supplied by the Utility Department.

The operating level of an economic activity is shown on the Economic Status Map. For most purposes a business' operating level is the only level considered by the computer programs. However, a business pays property taxes and maintenance for its constructed level.


TWOCITY
ECONOMIC STATUS MAP
ROUND 1
PARCEL KEY
TOP LEFT: OWNER
TOP RIGHT: ZONING
MIDDLE: LAND USE AND LEVEL
BOTTOM LEFT: UTILITY LEVEL
BOTTOM RIGHT: # UNDEVLPD LAND
PARCEL EDGES
.. .. ROADBED
-- II TYPE 1 ROAD
== HH TYPE 2 ROAD
## TYPE 3 ROAD
GG GG JURISDICTION BOUNDARY
INTERSECTIONS
* TYPE 1 TERMINAL
X TYPE 2 TERMINAL
# TYPE 3 TERMINAL
ZONING LAND USE
-- ANY USE
10 ANY BUSINESS
20 HI,LI,CI
21 HI
22 LI
23 CI
30 HS,BG,BS,PG,PS
31 HS
32 BG
ZONING USE
33 BS
34 PG
35 PS
40 RA,RB,RC
41 RA
42 RB
43 RC
50 PARKLAND

Government Status Map

Whereas there can be only one economic owner per parcel, any combination of government departments can own developed and undeveloped land on a parcel. The government departments which can own land, and the types of developments each can construct on a parcel, are:

Department:	Development:
Utility	Utility plant
	Water intake treatment plant
	Sewage outflow treatment plant:
	Chlorination
	Primary treatment
	Secondary treatment
	Tertiary treatment
School	School unit
Municipal Service	Municipal service unit
Planning and Zoning	Parkland & Public
Highway	Road*
	Terminal*

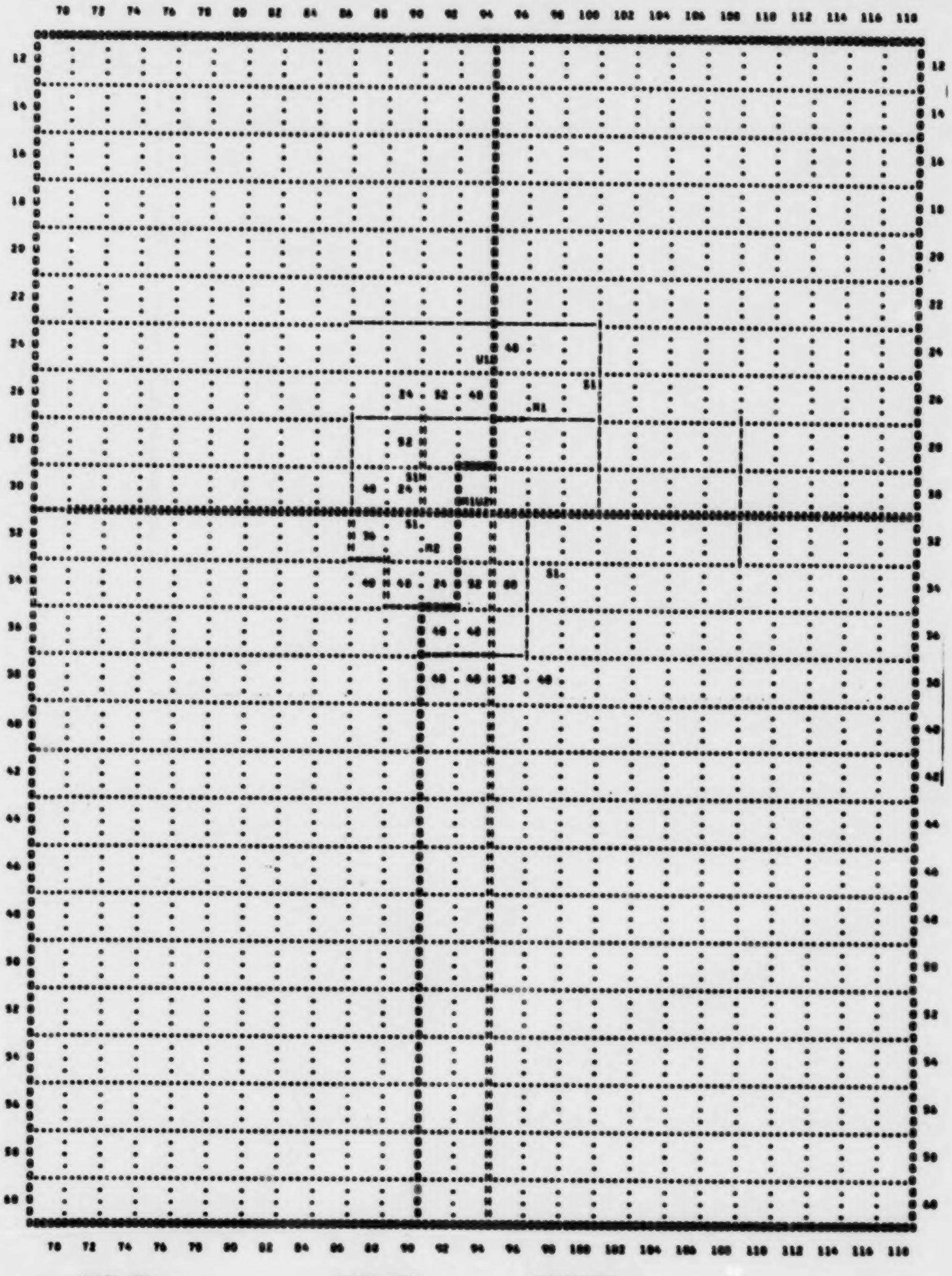
A government department can sell undeveloped land which it owns to either another government department or to the economic decision-maker owning the privately-owned portion of the parcel.

The government status map also shows the locations of some of the types of government activities: schools, parks, utility plants, and municipal service units.

---

*A road requires land from the parcels on each side, and a terminal requires land from the four parcels touching the intersection at which it is located. (See Master Tables, page 288).

```
                TWOCITY
                                      GOVERNMENT STATUS MAP                                ROUND 1
```



```
      PARCEL KEY                          PARCEL EDGES                   INTERSECTIONS
TOP RIGHT:     SCHOOL + LEVEL         -- .. ROADBED                    + TYPE 1 TERMINAL
MIDDLE ROW:    % UNDV PRKLND          == || TYPE 1 ROAD                E TYPE 2 TERMINAL
BOTTOM LEFT:   MS UNIT + LEVEL        == HH TYPE 2 ROAD                # TYPE 3 TERMINAL
BOTTOM RIGHT:  UT PLANT + LVL         ## HH TYPE 3 ROAD
                                      OO OO JURISDICTION BOUNDARY
```

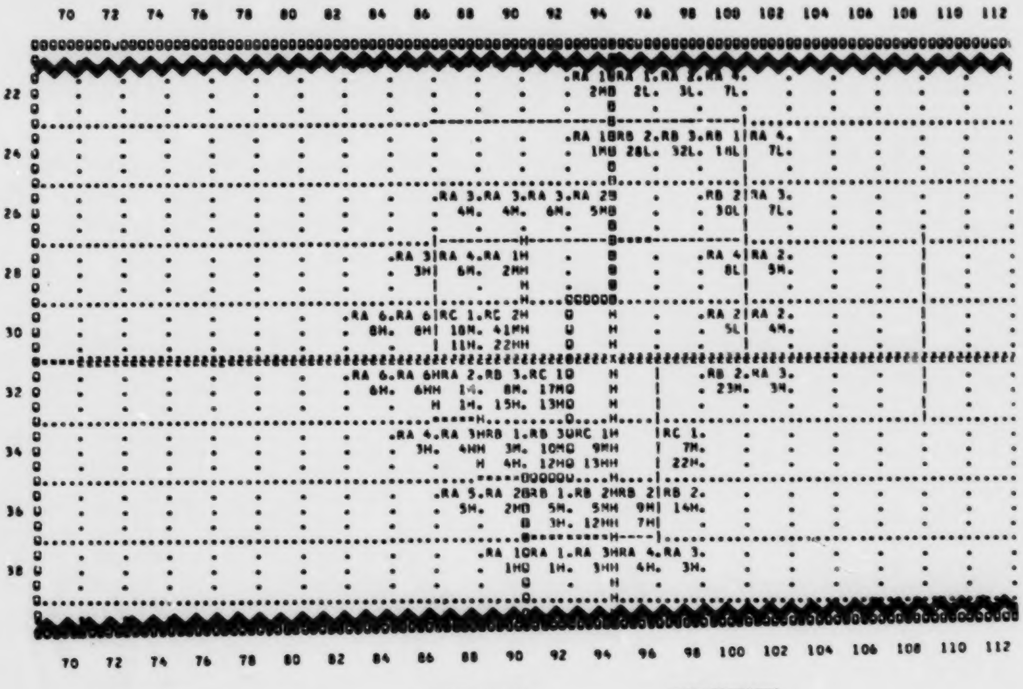
Socio-Economic Distribution Map

This map shows the number of PI's of each class living on each residence parcel. The residence type and level are also printed.

The migration process allocates people to housing. Only two classes can live on a residence parcel simultaneously, due in part to the model's restriction that a PH will not move into a residence with a quality index below 71 and a PL will not move into housing with a quality index above 70. It is possible, if a residence depreciates below the minimum that a class will accept, that high-income, for example, will live in a residence with a quality index below 71 if the class was living on the parcel before the depreciation. In no case, however, can PH's reside on the same parcel with PL's.

Each level of a residence type provides a fixed number of space units. A PI occupies a fixed number of space units, depending on its class. The percent occupancy of each residence is shown on the Demographic Map.

```
TWOCITY
SOCIO-ECONOMIC DISTRIBUTION MAP
```



```
      PARCEL KEY                                   PARCEL EDGES                 INTERSECTIONS
TOP ROW:    RESIDENCE TYPE AND LEVEL         .. .. ROADBED                      + TYPE 1 TERMINAL
MIDDLE ROW: NUMBER OF PI'S AND CLASS         -- || TYPE 1 ROAD                  X TYPE 2 TERMINAL
BOTTOM ROW: NUMBER OF PI'S AND CLASS         == HH TYPE 2 ROAD                  * TYPE 3 TERMINAL
                                             ZZ HH TYPE 3 ROAD
                                             OO OO JURISDICTION BOUNDARY
```

Demographic Map

The demographic map shows the number of people living on each residence parcel, the percent occupancy of each residence and the quality of all privately owned buildings. **Residential** overcrowding (over 100% occupancy) contributes to a residence's neighborhood index and to the health index.

The quality is expressed as the quality index for a residence and as the value ratio for non-residential activities. A value ratio is the ratio of the present condition of a business' buildings and equipment to their original condition, expressed as a percent.

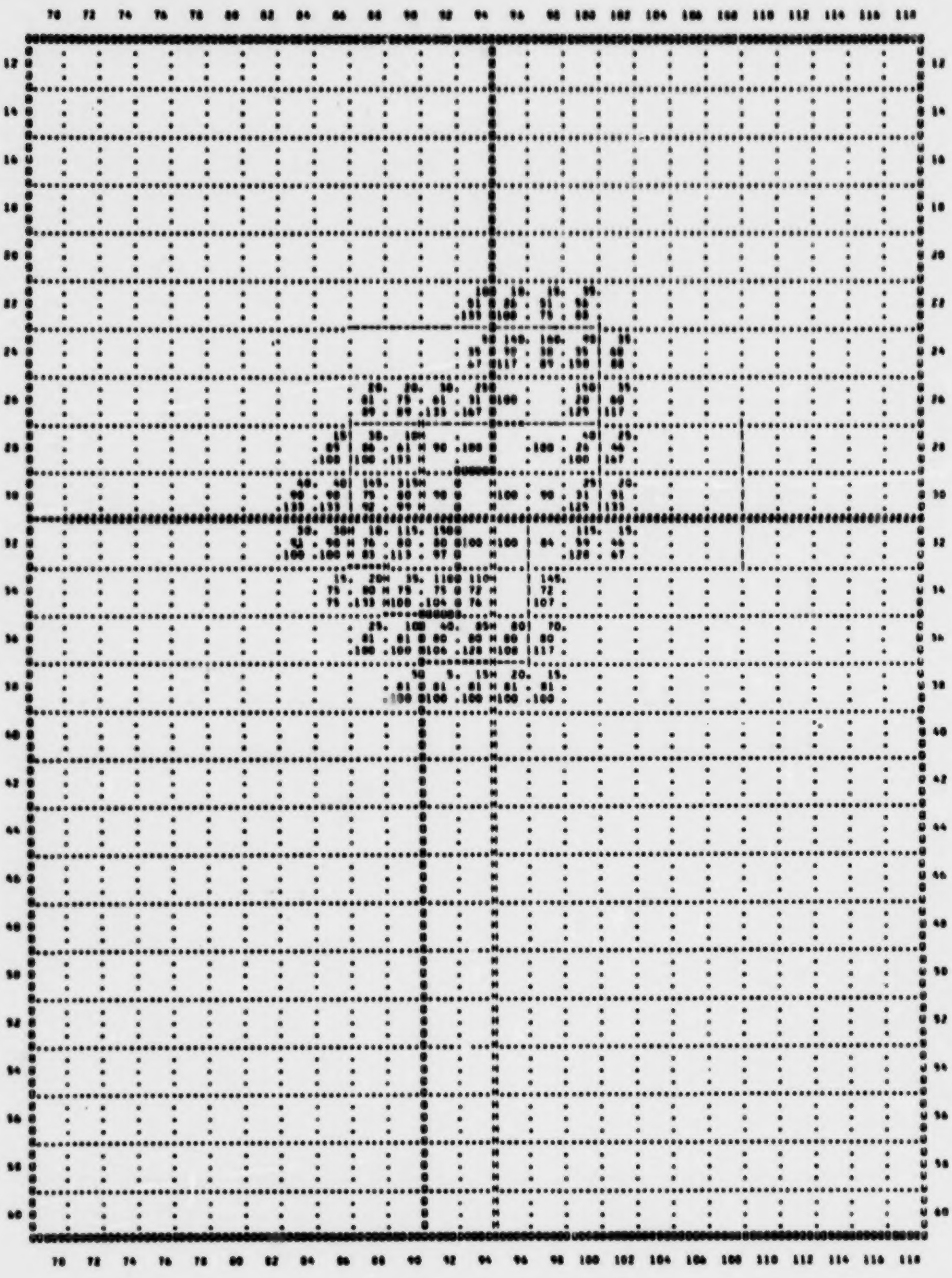
A quality index is somewhat different. Whereas a new business has a value ratio of 100, a new residence can have a quality index of from 40 to 100 designating its acceptability as a residence location for the various classes of people.

Each year buildings and equipment depreciate in response to several conditions which vary by type of activity (see the Economic Sector Master Tables, page**131**) for the causes of depreciation). A business's depreciation is measured as a percent of original value (100). A residence's depreciation is measured as a percent of the original value of such a type of residence originally built at a quality index of 100, regardless of the original quality of the specific residence. Thus, business depreciation is a percent of original value but residential depreciation is a percent of quality index 100.

The owner of an activity can set a maintenance level for the activity. The maintenance level is the quality index or value ratio at which the owner will maintain the activity, regardless of how much it depreciates in a year. Not until the activity's value ratio or quality index falls to its maintenance level does the owner incur maintenance expenditures. The computer program depreciates and maintains buildings and equipment and charges the owner for the maintenance cost.

The Demographic Map shows quality indexes and value ratios after depreciation and after any maintenance.

```
                   TWOCITY
                                         DEMOGRAPHIC MAP                                        ROUND 1
```



```
        PARCEL KEY                               PARCEL EDGES                INTERSECTIONS
TOP ROW:    TOTAL POP IN 100'S (RES)     .. .. ROADBED                  + TYPE 1 TERMINAL
MIDDLE ROW: DI (RES) OR VR (NR)          == II TYPE 1 ROAD              X TYPE 2 TERMINAL
BOTTOM ROW: % OCCUPANCY (RES)            -- HH TYPE 2 ROAD              * TYPE 3 TERMINAL
                                         88 88 TYPE 3 ROAD
                                         DD DD JURISDICTION BOUNDARY
```

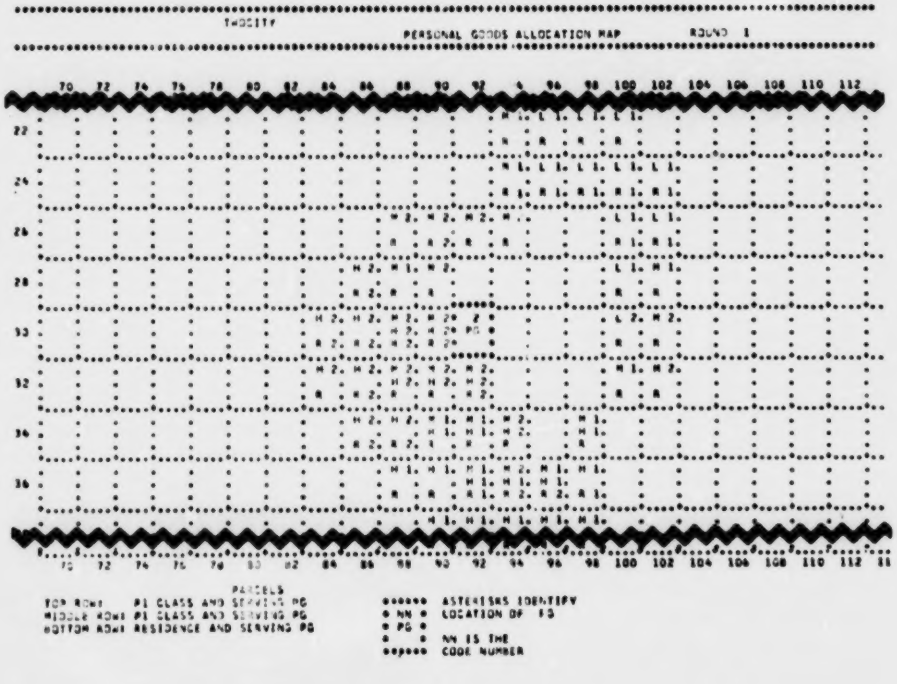
Personal Goods Allocation Map

This map identifies the location of Personal Goods establishments and identifies the PG establishments that serve the customers from each parcel of land that has residence on it. PG establishments are located on those parcels that are encircled by asterisks. Their code number is also shown on the parcel where they are located.

It is possible to have up to three distinct customers on a parcel of residential land: population units from two classes and the residence landlord. All population units purchase personal goods as part of their annual expenditures. All PI's of a class on a parcel purchase their personal goods at a single PG establishment. Landlords purchase personal goods only if they make maintenance expenditures. Buyers are assigned to specific commercial activities taking into account the price charged, transportation costs to the store, the capacity of the store, and boycotts.

The four letter-codes used within a parcel on the map are: L = low income, M = middle income, H = high income, and R = residence. One or two of the first three codes prints if population units live on the parcel. If no one occupies the housing, no income class code is printed. The number after the letter code is the PG establishment code. The outside system suppliers are identified by the number code "1".

The buyer code "R" will print on every parcel that has a residence. If the landlord makes maintenance expenditures, then the R is followed by a PG establishment code. No code after the R indicates that no maintenance is being performed on that residence parcel.


TWOCITY
PERSONAL GOODS ALLOCATION MAP
ROUND 1
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112
22
24
26
28
30
32
34
36
PARCELS
TOP ROW: PI CLASS AND SERVING PG
MIDDLE ROW: PI CLASS AND SERVING PG
BOTTOM ROW: RESIDENCE AND SERVING PG
ASTERISKS IDENTIFY LOCATION OF PG
NN
PG
NN IS THE CODE NUMBER

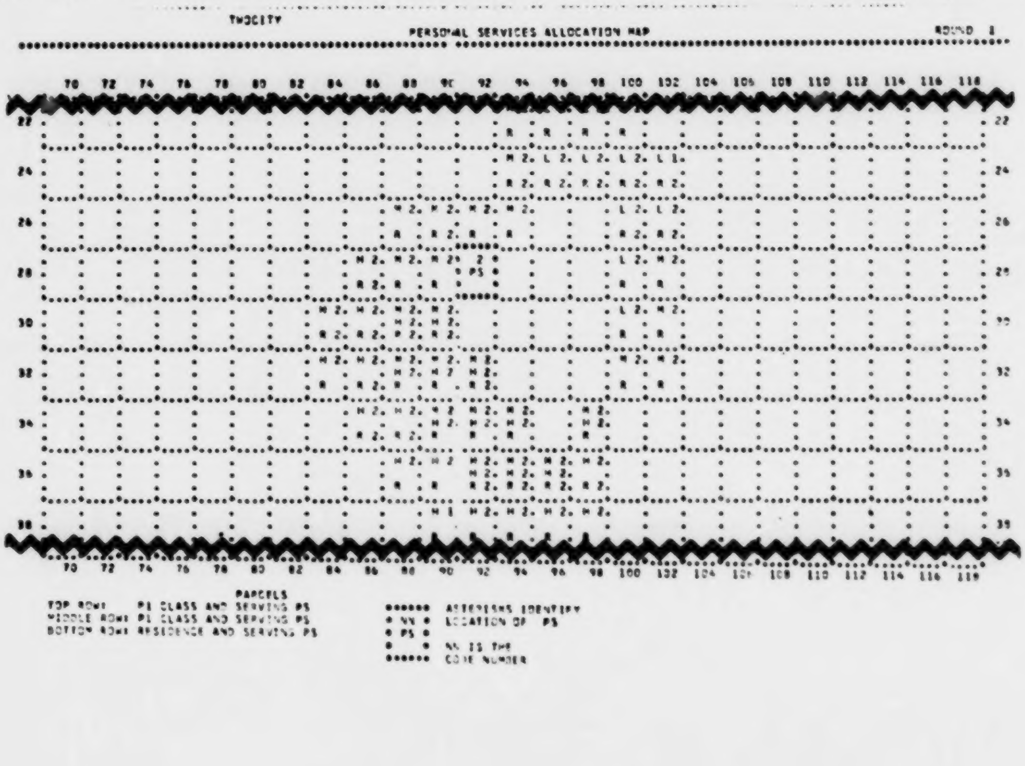
Personal Services Allocation Map

This map identifies the location of Personal Services establishments and the PS establishment that serves the customers from each parcel of land that has residences on it. PS establishments are located on those parcels that are encircled by asterisks. Their code number is also shown on the parcel where they are located.

It is possible to have up to three distinct customers on a parcel of residential land: population units from two classes and the residence landlord. (No more than two classes of population may live on a single residential parcel.) All population units purchase personal services as part of their annual expenditures. All PI's of a class on a parcel purchase their personal services at a single PS establishment. Landlords purchase personal services only if they make maintenance expenditures. Buyers are assigned to specific commercial activities taking into account price charged, transportation costs to the store, capacity of the store, and boycotts.

The four letter-codes used within a parcel on the map are L = low income, M = middle income, H = high income, and R = residence. One or two of the first three codes prints if population units live on the parcel. If no one occupies the housing, no income class code is printed. The number after the letter code is the PS establishment code. The outside system suppliers are identified by the number code "I".

The buyer code "R" will print on every parcel that has a residence. If the landlord makes maintenance expenditures then the R is followed by a PS establishment code. No code after the R indicates that no maintenance is being performed on that residence parcel.


TWOCITY
PERSONAL SERVICES ALLOCATION MAP
ROUND 1
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
22 24 26 28 30 32 34 36 38
PS
PARCELS
TOP ROW: PI CLASS AND SERVING PS
MIDDLE ROW: PI CLASS AND SERVING PS
BOTTOM ROW: RESIDENCE AND SERVING PS
ASTERISKS IDENTIFY LOCATION OF PS
NN IS THE CODE NUMBER

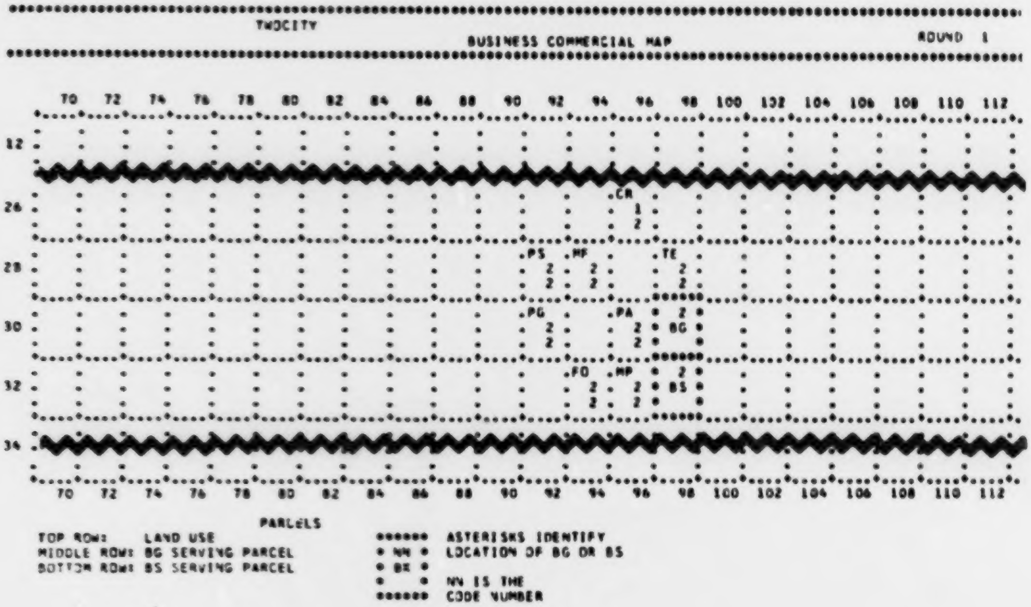
Business Commercial Map

This map identifies the location of Business Goods (BG) and Business Services (BS) establishments and indicates the establishment code number for BG and BS establishments serving economic activities.

BG and BS establishments are located on those parcels that are encircled by asterisks, and their identification number is shown. The outside system suppliers are always assigned the establishment code of "l".

Local economic activities (industries and PG and PS commercial establishments) purchase BG and BS as part of their annual operation requirements. Buyers are assigned to a single specific supplier taking into account prices charged, transportation costs to the commercial establishments, capacity of the establishments, and boycotts.

The parcels on which buyers of BG and BS are located show the two-letter code for the business activity and the number code of the BG establishment serving it (second line) and the number code of the BS establishment serving it (third line).


TWOCITY
BUSINESS COMMERCIAL MAP
ROUND 1
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112
12
26
28
30
32
34
CR
PS
MF
TE
PG
PA
BG
FO
MP
BS
PARCELS
TOP ROW: LAND USE
MIDDLE ROW: BG SERVING PARCEL
BOTTOM ROW: BS SERVING PARCEL
ASTERISKS IDENTIFY
LOCATION OF BG OR BS
NN IS THE
CODE NUMBER

Surface Water Map

The Surface Water Map displays those characteristics of a surface water system which do not change dynamically during a particular run of the model. For each parcel on which there is surface water, the map shows the volume of water, its rate of flow, and the percent of the surface area of the parcel which is water.

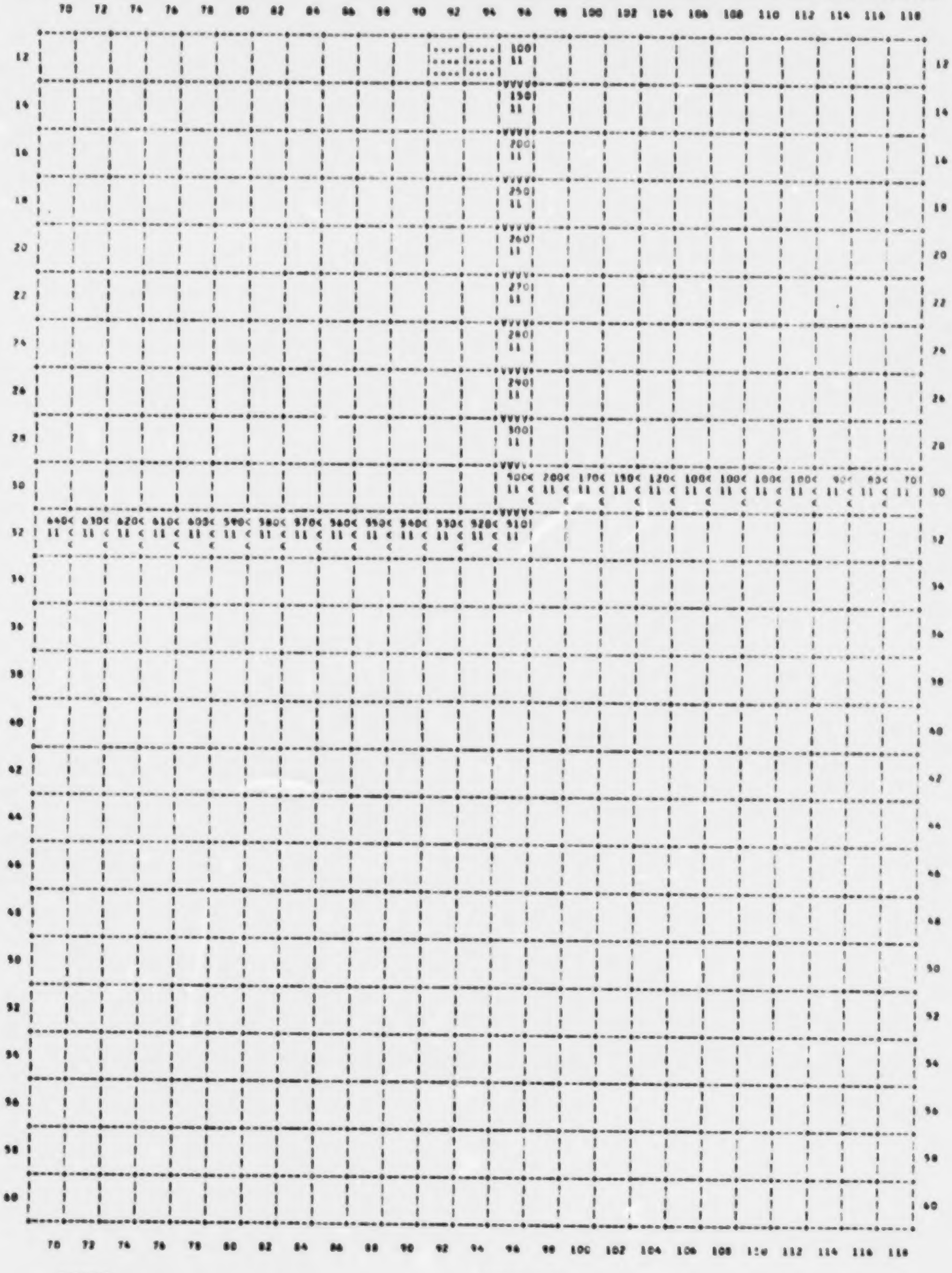
The volume of water on a parcel is measured in millions of gallons per day (MGD) passing any one point on the parcel. The volume of water on a parcel affects both the water quality and the amount of water which can be removed for municipal and industrial use. The amount of surface area occupied by water has one effect in the model: it preempts a portion of the parcel from use in other activities.

The rate of flow of water on a parcel is measured in the number of parcels which water flowing at that rate would cross in one day. Water bodies undergo a natural cleansing process. The slower a river flows, the less distance some types of pollutants travel before they are naturally removed from the river.

The map also displays the direction of the river's flow. The arrows between parcels point in the direction that the water flows. Water flows from parcel to parcel, traveling within parcels. If a parcel has a volume of water but no arrows pointing away from it, it either is the last parcel through which a river flows or has a self-contained surface water system which does not interact with the other surface water system parcels.

A parcel which is displayed as all dots is entirely water, usually a very large body of water into which a river flows, such as a large lake or ocean. The water on such a parcel does not interact with the surface water represented in the model; its quality is affected by activities in an area much greater than the simulated area. For convenience, such a water body is termed a lake in the model.

```
                          INDCITY
                      SURFACE WATER MAP                                                ROUND  1
```



70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
100 11
150 11
200 11
250 11
260 11
270 11
280 11
290 11
300 11
500< 200< 170< 150< 120< 100< 100< 100< 100< 90< 80< 70
640< 630< 620< 610< 600< 590< 580< 570< 560< 550< 540< 530< 520< 510

```
PARCELS                                      PARCEL EDGES
-------                                      ------------
   TOP ROW: AMOUNT OF SURFACE WATER          >AV<  DIRECTION OF FLOW
            ON PARCEL  (MGD)                 ----  NO WATER FLOWING
MIDDLE ROW: RATE OF FLOW                           BETWEEN PARCELS
BOTTOM ROW: PERCENT OF SURFACE AREA
            OF PARCEL IN WATER
....
....  LAKE PARCELS
....
```

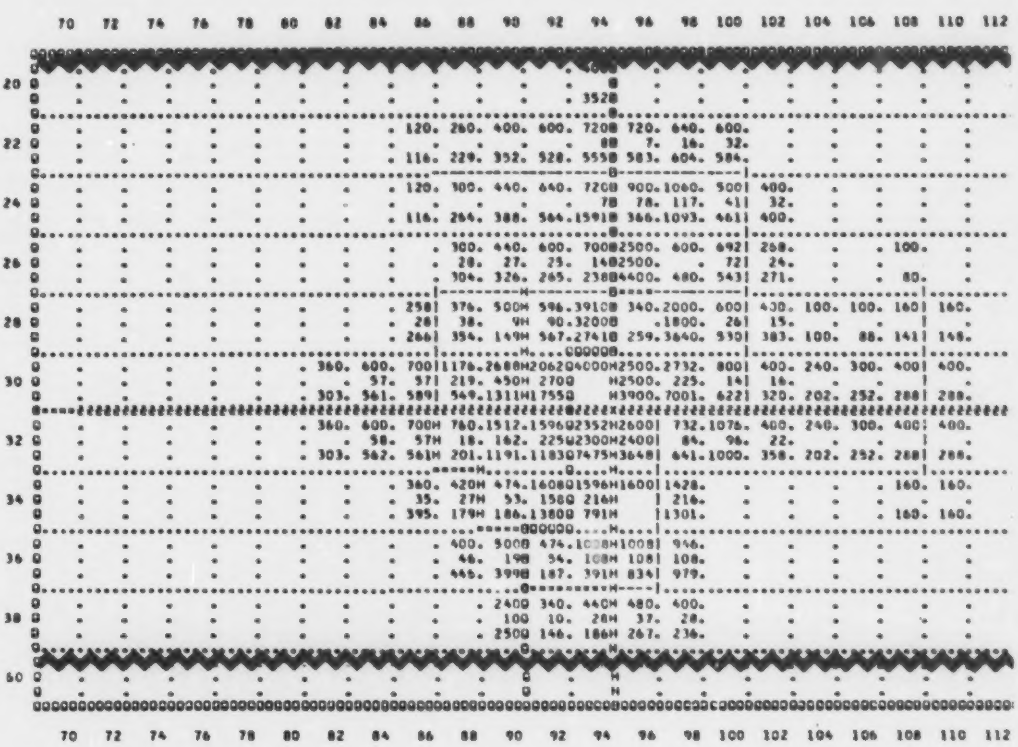
Market value map

This map designates the jurisdictional boundaries (000) and the highway system (including terminals). Nonfarm parcels of land that are owned by local decision-makers contain information on the market value of the land and developments on the parcel (values are in $100,000's).

The top row of each such parcel indicates the market value of 100% of the land on the parcel. This value is printed so that comparisons may be made from one parcel to another without having to take into consideration what percent of each parcel is privately owned. Since there is usually some land on most parcels that is not privately owned (schools, parks, roads, water bodies, etc.), the actual market values of the land will be somewhat less than indicated on the map.

The middle row indicates the market value of all private developments. (This value is equal to the original value times the value ratio).

```
TWOCITY
MARKET VALUE MAP
```



```
         PARCEL KEY                              PARCEL EDGES                      INTERSECTIONS
TOP ROW:    MKT VALUE OF 100% OF LAND       .. .. ROADBED                       + TYPE 1 TERMINAL
MIDDLE ROW: MKT VALUE OF PRIV BLDGS         -- || TYPE 1 ROAD                   XTYPE 2 TERMINAL
BOTTOM ROW: MKT VAL OF PRIV LAND & BLDGS    == HH TYPE 2 ROAD                   * TYPE 3 TERMINAL
       ALL VALUES IN $100,000'S             ## ## TYPE 3 ROAD
                                            00 00 JURISDICTION BOUNDARY
```

Assessed value map

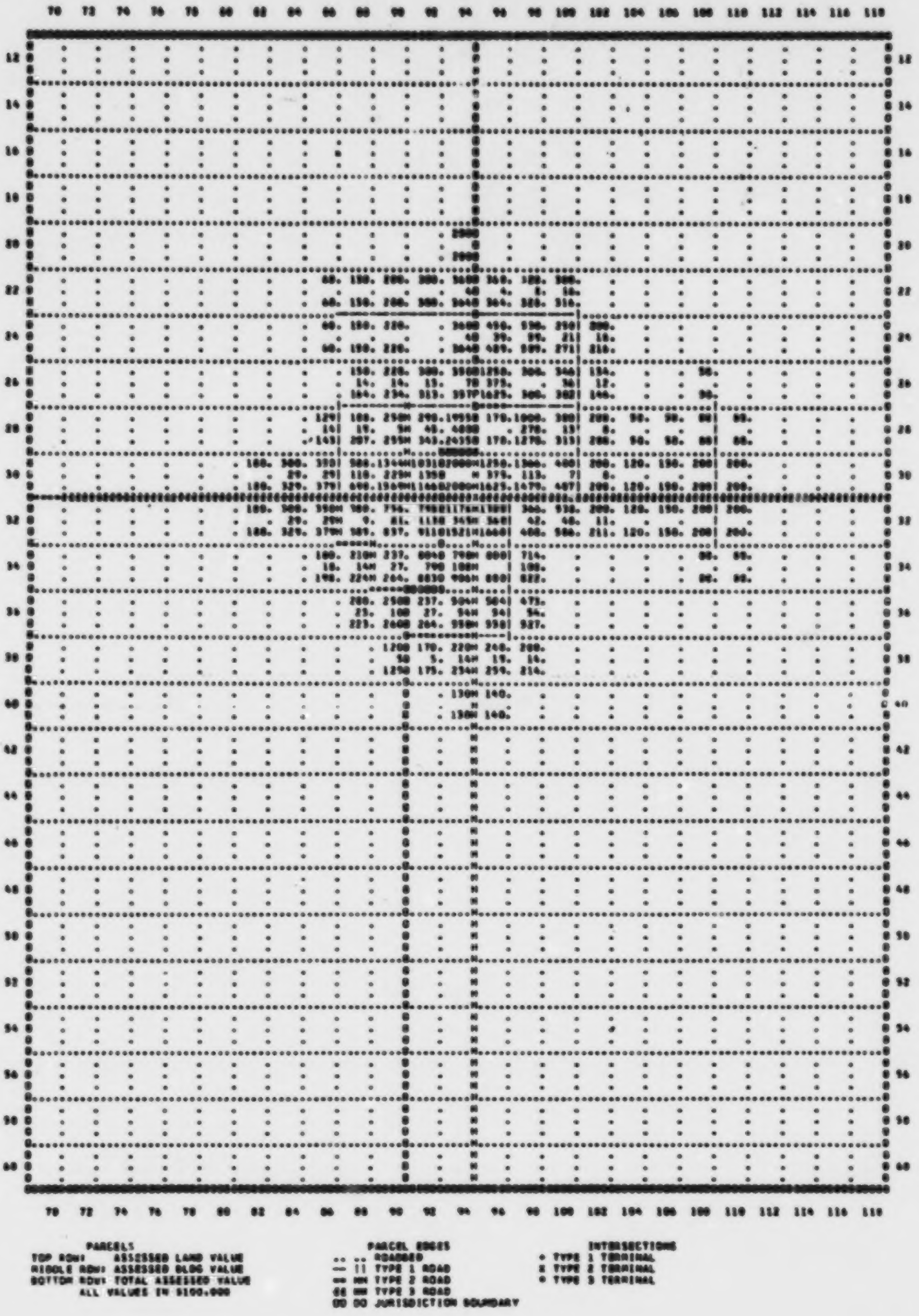
This map shows the assessed values of non-farm land and of developments on the land for those parcels of land that are owned by economic teams. The top number on a parcel square is the assessed value of 100% of the land. Assessed values of land are created in two ways. First, land that is newly purchased at a price higher than the previous market value is given a new market value equal to the sale price and a new assessed value that is dependent upon the jurisdiction's assessment ratio for developed or undeveloped land. Second, local assessment policy helps determine assessed value.

The second number is the assessed value of the development on the parcel. If no number appears in this position, the land is undeveloped. Assessed values of developments are changed through new constructions, declining market values of developments (deterioration), and changes in the development assessment ratios.

The Assessment Department may change the assessed values of developments by changing the jurisdiction-wide development ratio for specific parcels, or by inputting a dollar value of the development assessment (this decision lasts for only one round and must be input each round for which the dollar assessed value is to remain the same).

The last line on a privately-owned land parcel shows the total (land and development) assessed value. The dollar values on this map are expressed in a scale factor ($1m; $100,000; or $10,000) that is chosen by the computer based upon the highest and lowest dollar values represented on the map. Therefore, the map key is adjusted automatically when the need arises. This map also shows jurisdictional boundaries, the road network, and the location of terminals.

```
TWOCITY
                    ASSESSED VALUE MAP                    ROUND 1
```

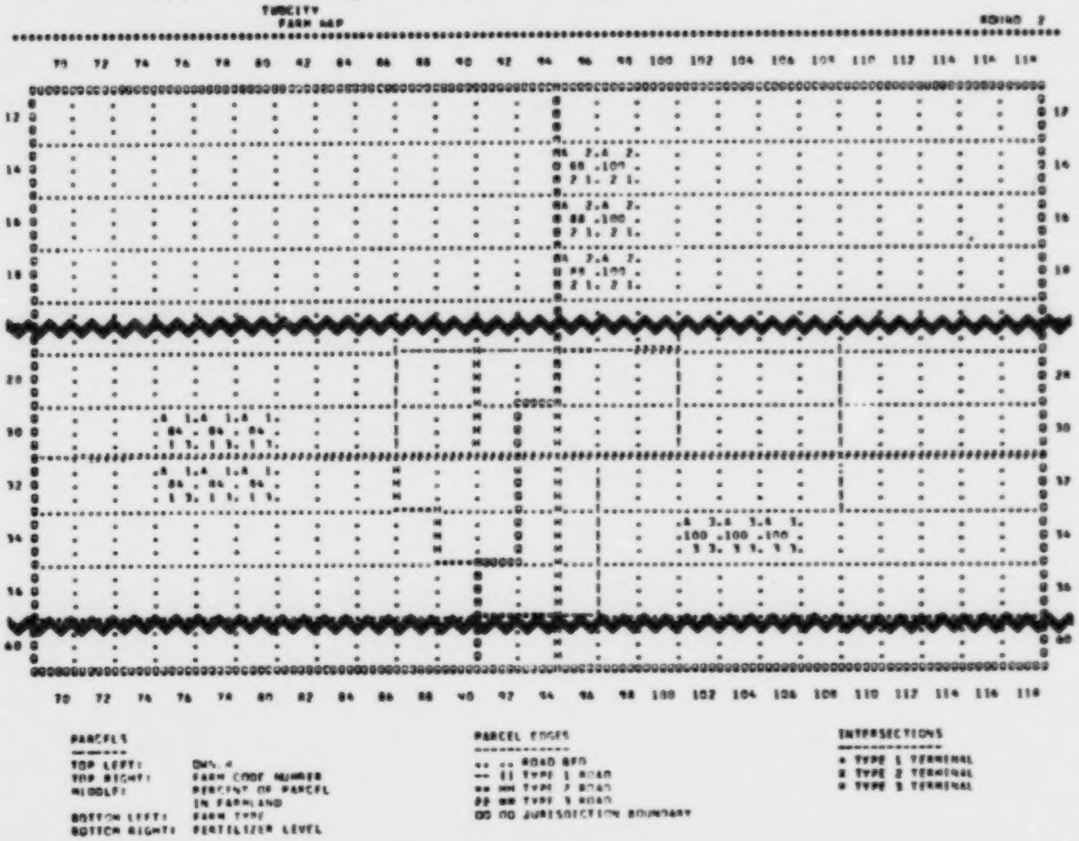

70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60

```
      PARCELS                            PARCEL EDGES                  INTERSECTIONS
TOP ROW:    ASSESSED LAND VALUE          .. .. ROADBED                 + TYPE 1 TERMINAL
MIDDLE ROW: ASSESSED BLDG VALUE          -- II TYPE 1 ROAD             X TYPE 2 TERMINAL
BOTTOM ROW: TOTAL ASSESSED VALUE         == HH TYPE 2 ROAD             * TYPE 3 TERMINAL
      ALL VALUES IN $100,000             EE ## TYPE 3 ROAD
                                         OO OO JURISDICTION BOUNDARY
```

Farm map

A farm can contain more than one parcel. All of the parcels in a single farm have the same owner, farm code number, farm type, and fertilizer level. The amount of land in farm use may be different for the different parcels in a single farm. The rest of the land can be in public use or can be topographically unusable. No other economic activity can be located on a farm parcel. When the economic owner of a farm parcel changes, the parcel ceases to be classified as a farm. Once an initial starting configuration of the board has been selected, no new farms can be created.

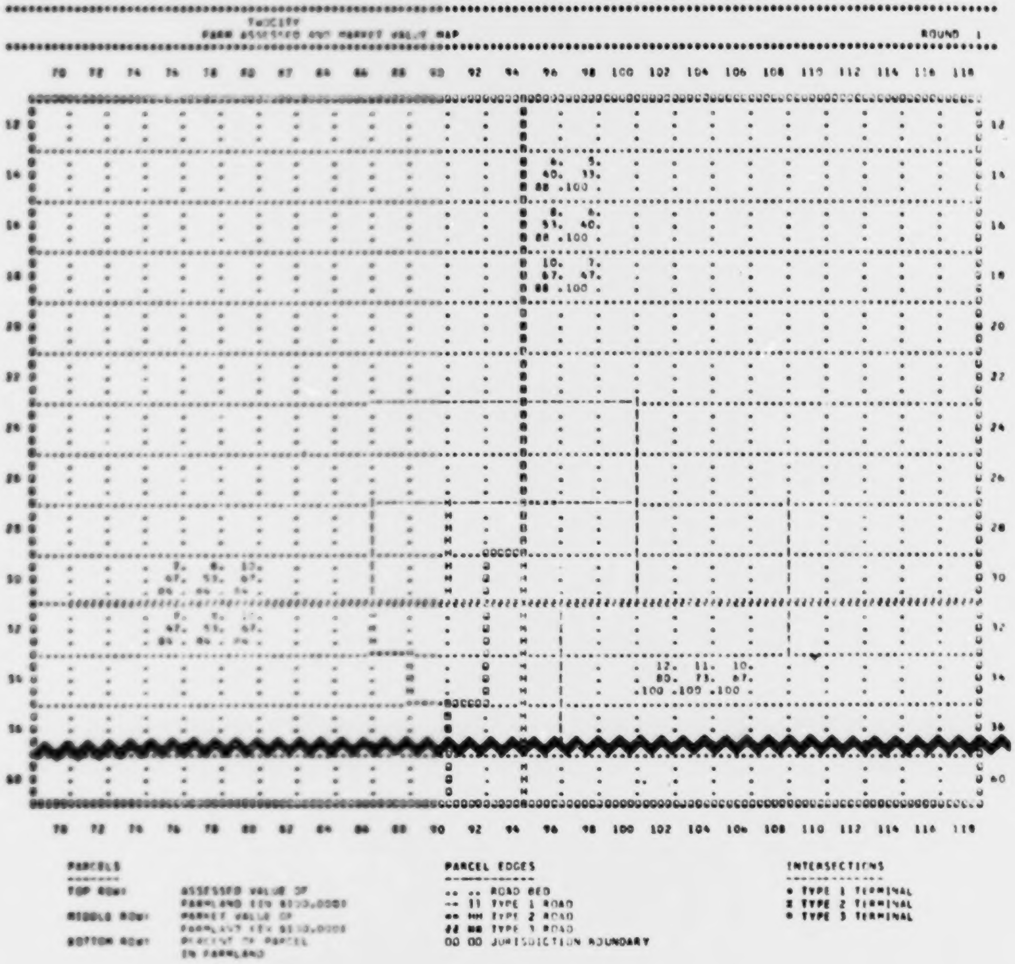
There are two types of decisions which a farm owner can make: set the fertilizer level for a farm and sell part or all of the farmland on a farm. A farm's fertilizer level (an integer from 0 to 3) is associated with multipliers which represent the increase in normal income which occurs at that fertilizer factor for the farm type. A farm owner's income increases as he sets a higher fertilizer factor level. Likewise, the amount of pollution on a farm's runoff increases with the fertilizer level. Volume of runoff stays the same for a farm parcel regardless of the amount of land on that parcel in farm activity. When a parcel is no longer a farm, no more runoff exists.


TWOCITY
FARM MAP
ROUND 2
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
PARCELS
TOP LEFT: OWN.#
TOP RIGHT: FARM CODE NUMBER
MIDDLE: PERCENT OF PARCEL IN FARMLAND
BOTTOM LEFT: FARM TYPE
BOTTOM RIGHT: FERTILIZER LEVEL
PARCEL EDGES
.. .. ROAD BED
-- II TYPE 1 ROAD
== HH TYPE 2 ROAD
## TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
# TYPE 3 TERMINAL

Farm assessed and market value map

The value shown for a farm parcel on the map is for that portion of a parcel which is in farm use. The ratio of assessed value to market value is set by the Assessor of the jurisdiction in which a farm is located. A farm owner pays local property taxes at the rate set by the Chairman and on the base set by the Assessor of the jurisdiction in which the farm is located. A farm's net income before taxes is fixed according to the farm's maintenance level, the amount of land at the farm and the farm type. The only variable expenditure is local property tax.

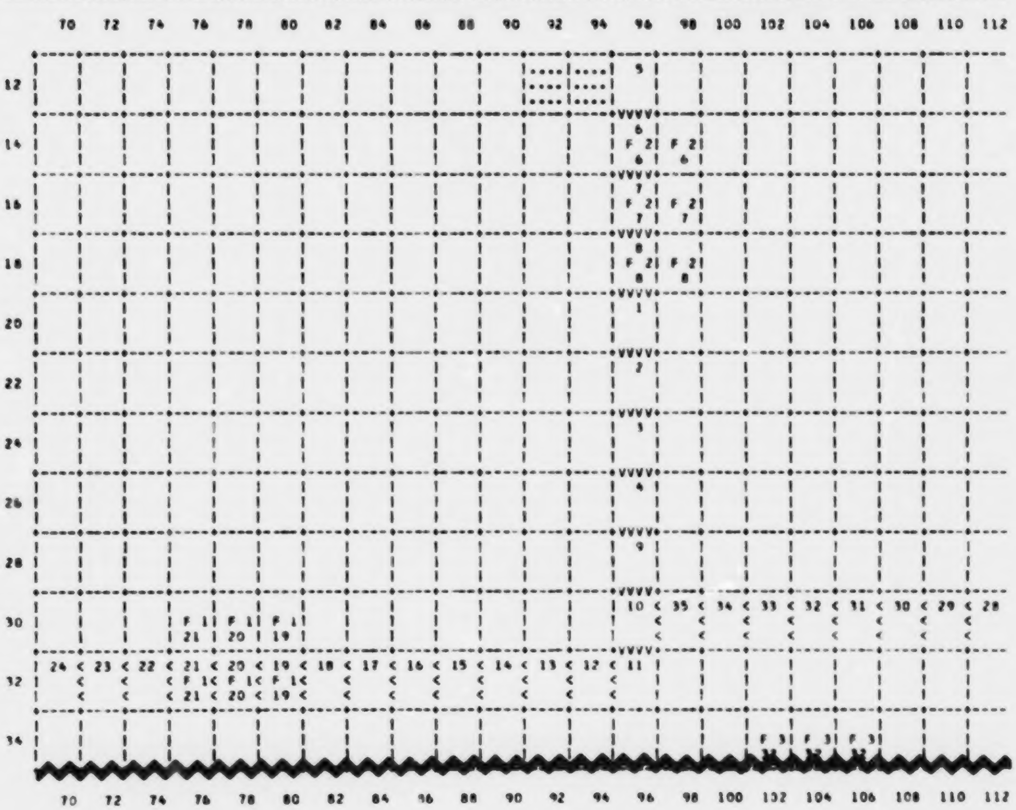
On the map, only those parcels on which land is designated as farmland will have numbers. The top number is the assessed value of the land. The middle number is the market value of the land. The bottom number is the percent of the parcel which is farmland. Also shown on the map are jurisdiction boundaries, roads, and terminals.


TAXCITY
FARM ASSESSED AND MARKET VALUE MAP
ROUND 1
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 60
PARCELS
TOP ROW: ASSESSED VALUE OF FARMLAND (IN $100,000)
MIDDLE ROW: MARKET VALUE OF FARMLAND (IN $100,000)
BOTTOM ROW: PERCENT OF PARCEL IN FARMLAND
PARCEL EDGES
.. .. ROAD BED
-- II TYPE 1 ROAD
== HH TYPE 2 ROAD
## TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
* TYPE 1 TERMINAL
X TYPE 2 TERMINAL
# TYPE 3 TERMINAL

Farm runoff map

Farms do not use surface water or municipally-supplied water. Their water requirements are assumed to be met by rain or ground water. However, some of the water which falls on farms runs into the surface water. Farms use fertilizer, and the resulting nutrients flow into the surface water. The program assigns each surface water parcel a code number, which is printed on the top row of parcels containing surface water. Wherever there is a farm, the middle row shows 'F' and the farm type. Different types of farms have different basic fertilizer requirements and net incomes from sales. On a farm parcel the bottom row of the parcel shows the code number of the surface water parcel onto which the farm parcel's runoff flows. A farm owner sets a level of fertilizer use for the farm. The higher the fertilizer level, the greater the concentration of nutrients in the runoff from the parcels comprising the farm.

```
TWOCITY
FARM RUNOFF MAP
```


70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112
12
14
16
18
20
22
24
26
28
30
32
34
5
6
F 2
7
8
1
2
3
4
9
10 < 35 < 34 < 33 < 32 < 31 < 30 < 29 < 28
F 1
21
20
19
24 < 23 < 22 < 21 < 20 < 19 < 18 < 17 < 16 < 15 < 14 < 13 < 12 < 11
F 1
F 3

```
PARCELS                                          PARCEL EDGES        ....
-------                                          ------------        ....  LAKE PARCELS
   TOP ROW: (FOR SURFACE WATER PARCELS)          >AV<  DIRECTION OF FLOW  ....
            CODE NUMBER OF PARCEL                ----  NO WATER FLOWING
MIDDLE ROW: FARM TYPE                                  BETWEEN PARCELS
BOTTOM ROW: PARCEL WHERE RUNOFF FLOWS
```

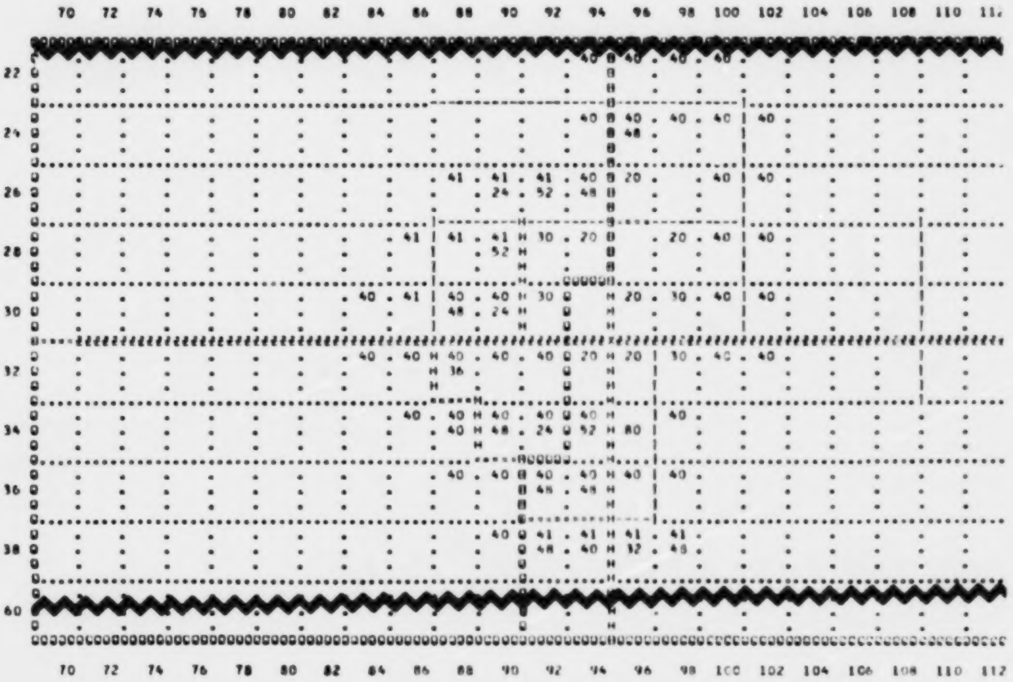
Planning and zoning map

This map shows the zoning that is in effect on each parcel of land for which the local jurisdiction has designated a zoning code. New land uses must conform to the zoning classifications. Existing land uses are not forced to change as the result of new zoning classifications that are inconsistent, however, under such conditions they cannot expand from their present constructed level. Parcels that have no zoning do not have any construction limits placed upon them. The land uses allowed under each zoning classification are shown in the Economic Master Table, in the Planning and Zoning Master Table, and on the map legend.

The percent of each parcel devoted to parkland and public institutional land is also shown on this map. Parkland is operated by the Planning and Zoning Department and serves the community in the form of football and baseball fields, picnic areas, hiking trails, and wooded land. Public institutional land contains costly public recreation facilities such as museums, art galleries, libraries, and sports arenas.

This map also shows the road network, terminals and jurisdictional boundaries.

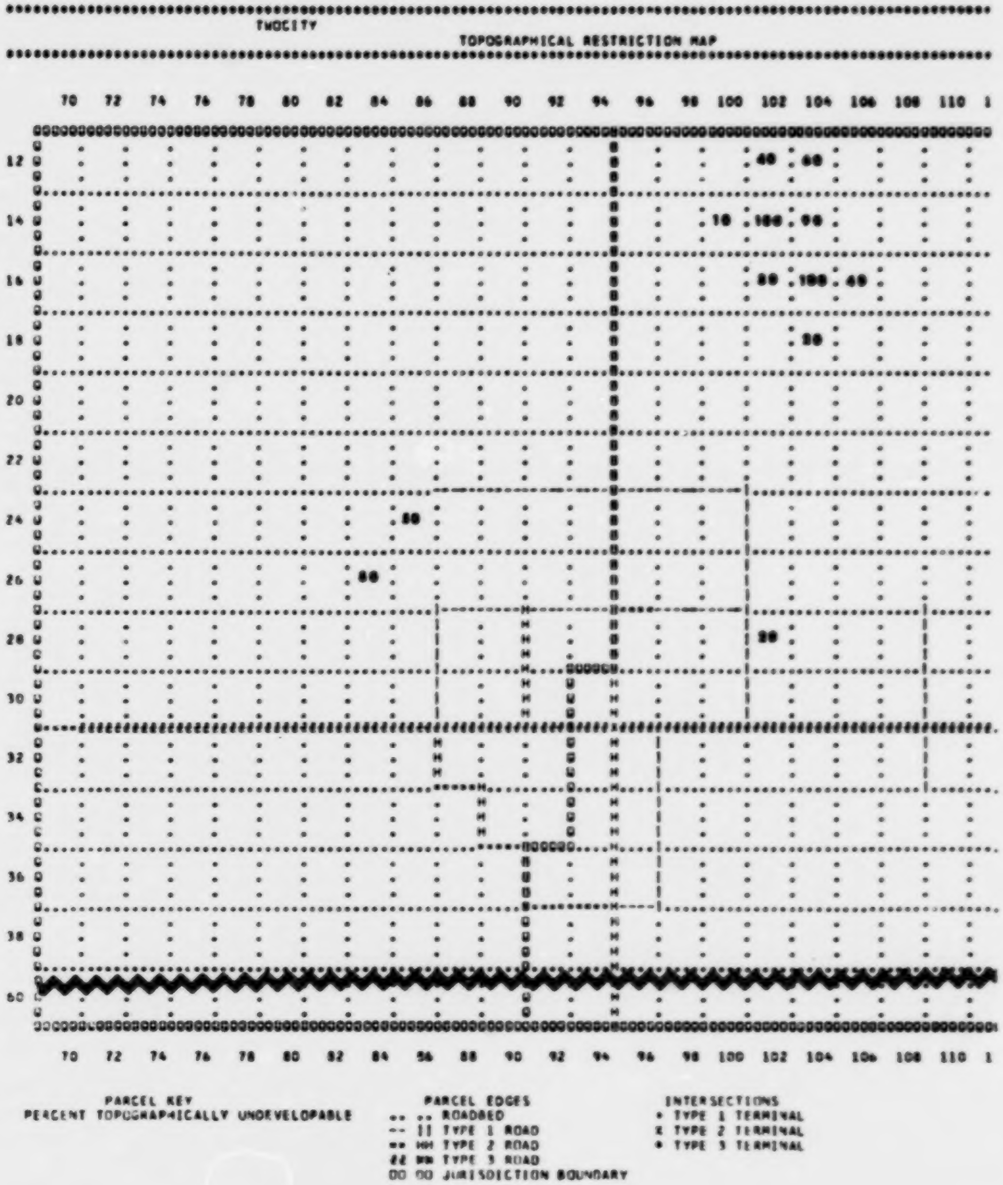
```
TWOCITY
                    PLANNING AND ZONING MAP
```



```
                PARCELS                       PARCEL EDGES                 INTERSECTIONS          ZONING  LAND USE          ZONING  USE
TOP ROW:     ZONING                  .. ..  ROADBED                 + TYPE 1 TERMINAL      --    ANY USE                33    BS
MIDDLE ROW:  % PARKLAND              -- ||  TYPE 1 ROAD             # TYPE 2 TERMINAL      10    ANY BUSINESS           34    PL
BOTTOM ROW:  % PUB INST LAND         == HH  TYPE 2 ROAD             * TYPE 3 TERMINAL      20    HI,LI,CI               35    PS
                                     ## BB  TYPE 3 ROAD                                    21    HI                     40    RA,RB,RC
                                     OO OO  JURISDICTION BOUNDARY                          22    LI                     41    RA
                                                                                           23    CI                     42    RB
                                                                                           30    NS,RG,BS,PG,PS         43    RC
                                                                                           31    NS                     50    PARKLAND
                                                                                           32    RG
```

Topographical Restriction Map

This map shows the percent of a parcel that may not be purchased or developed by any local decision-makers. Land that is topographically undevelopable includes mountains, rock outcrops, swamps. None of the area consumed by water bodies represented in the local system (large lakes, small lakes, and rivers) is shown on this map. The map shows jurisdictional boundaries, the road network, and the location of terminals.

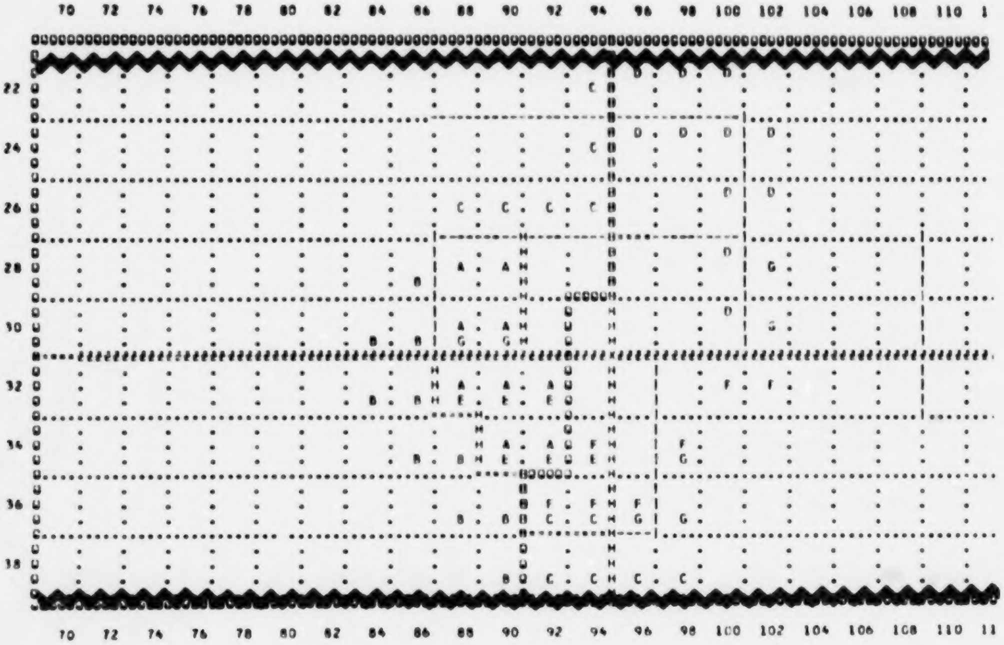

TWOCITY
TOPOGRAPHICAL RESTRICTION MAP
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 1
12 14 16 18 20 22 24 26 28 30 32 34 36 38 60
40
60
10
100
90
80
100
40
80
80
80
20
PARCEL KEY
PERCENT TOPOGRAPHICALLY UNDEVELOPABLE
PARCEL EDGES
.. .. ROADBED
-- || TYPE 1 ROAD
== HH TYPE 2 ROAD
## WW TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY
INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
* TYPE 3 TERMINAL

Social decision-maker map

This map indicates which social players make decisions for the low, middle, and high income population units on parcels. The top letter on a given parcel represents the social decision-maker who controls the PL's who live there, and the middle and lower letters represent the social decision-makers who control the PM's and PH's, respectively. If a particular class does not live on a parcel, no letter is printed.

Not until a parcel is developed for residential land use and occupied by at least one income class will a social decision-maker for that parcel appear on the map. Note that different decision makers may control the different population classes on a single parcel. Social teams acquire control over additional PI's on a parcel when the number of PI's of that class moving into the parcel exceeds the number moving out. They lose control of PI's when the number of that class moving out is greater than the number moving in. Social teams may also find that, from round to round, they gain or lose control of all the population units on a residential parcel of land. This occurs as a result of the migration of PI's of a class to a parcel where previously there were no PI's of that class (a gain) or as a result of the migration away from a parcel of all the PI's of a class on that parcel (a loss).

```
                   TWOCITY
                                        SOCIAL DECISION MAKER MAP
```



```
      PARCEL KEY                       PARCEL EDGES              INTERSECTIONS
TOP ROW:     LOW SOC D-M           .. .. ROADBED              + TYPE 1 TERMINAL
MIDDLE ROW: MID SOC D-M           -- II TYPE 1 ROAD           X TYPE 2 TERMINAL
BOTTOM ROW: HI SOC D-M            == HH TYPE 2 ROAD           * TYPE 3 TERMINAL
                                  ## MM TYPE 3 ROAD
                                  00 00 JURISDICTION BOUNDARY
```

SUMMARY OUTPUT INFORMATION

Demographic and economic statistics

This output summarizes a wide variety of information about the simulated region. There are two basic types of information: statistics by jurisdiction and for the region as a whole about local conditions, and measures of interactions between the region and the Outside System. The former provide comparisons between jurisdictions; the latter provide comparisons between the local and Outside systems.

Statistics Regarding Local Conditions

Total population: the number of people (not PI's), by class.

Percent change over previous year: the total population change, positive or negative, between the current round and the previous round. This is given only as a total and not broken down by jurisdiction.

Average population per parcel: the number of people divided by the number of parcels.

Developed land (in parcels): the amount of land area (in parcel equivalents) consumed by public and private developments.

Undeveloped land: the amount of land area (in parcel equivalents) not consumed by developments.

Total land area: the number of parcels.

Assessed value of land: the property tax base (in millions).

Assessed value of developments: the development tax base (in millions).

Average quality of life index: a measure across classes of the people's average quality of life index. The higher the index, the poorer the quality of life. The indexes may differ significantly within a jurisdiction, but only averages are given here.

Number of registered voters: the number of people eligible to vote, from which the number who actually vote are selected.

Number in public adult education: the number of people who wanted public adult education programs and for whom programs were provided by their school departments.

Average educational level: by class, the average educational level ranging from 0 to 100. The higher a worker's educational level relative to other workers, the greater his chances of being hired before others.

Number of workers receiving welfare: if a jurisdiction has a program to aid unemployed, this number is the number of unemployed workers. The number is zero if there is either no unemployed workers or no welfare program.

Student/teacher ratio: ratio of number of students to number of teachers at local public schools.

	FL	SG	MP	MF	NL	FL	TE	FO	TA	PA	CR	NS
INCOME FACTORS **************												
NORMAL PRICE PER UNIT SOLD (THOUSANDS OF DOLLARS)	196	155	176	232	147	200	184	148	10[illegible]	183	185	110
TYPICAL INCOME FROM SALES (MILLIONS OF DOLLARS)	196	155	176	232	147	200	184	148	100	183	185	110
EXPENDITURES ************												
BUSINESS GOODS (UNITS)	400	200	140	300	10[illegible]	400	200	30	20	100	150	60
BUSINESS SERVICES (UNITS)	120	40	35	180	54	246	174	10	10	44	50	23
PURCHASES PER 1% MAINTENANCE												
BG UNITS	10	8	10	8	8	6	10	5	4	4	4	1
BS UNITS	2	1	4	4	4	4	6	2	2	2	5	4
TYPICAL UTILITIES COSTS (MILLIONS OF DOLLARS)	0.5	1.0	7.0	1.0	1.0	2.0	2.0	3.0	1.0	3.0	4.0	0.76
WATER (MILLIONS OF DOLLARS)												
RECYCLING (ASSUMING 100 % RECYCLED)	3.17	0.0	11.70	0.0	0.0	0.0	0.0	2.55	0.88	17.32	1.61	0.0
INTAKE PROCESS (ASSUMING WATER QUALITY OF 4)	1.59	0.0	5.85	0.0	0.0	0.0	0.0	1.27	0.44	8.66	0.81	0.0
OUTFLOW TREATMENT (MAXIMUM OPERATING COST IN THOUSANDS)												
CL	397	0	1463	0	0	0	0	319	111	2165	202	0
PT	1586	0	5850	0	0	0	0	1274	442	8658	806	0
ST	3172	0	11700	0	0	0	0	2548	884	17316	1612	0
TT	4758	0	17550	0	0	0	0	3822	1326	25974	2418	0
MUNICIPAL SUPPLY (ASSUMING WATER COSTS OF $450 PER MG) (MILLIONS OF DOLLARS)	0.0	1.17	0.0	1.05	1.40	0.58	0.94	0.0	0.0	0.0	0.0	0.02
TRANSPORTATION (PER UNITS OF OUTPUT ON TYPE 3 ROAD)												
TO BG	2500	6000	7000	2700	7000	1000	2500	1000	5000	2000	2000	1250
TO BS	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500	1250
TO TERMINAL	2500	2000	2000	1500	1000	500	1500	1000	500	1500	1000	0
TERMINAL UNITS CONSUMED	1000	10000	6000	2000	1000	1000	2000	3000	1000	3000	3000	0
SALARIES (FULL EMPLOYMENT)	DEPENDS UPON SALARY LEVELS OFFERED.											
TAXES												
PROPERTY	LOCAL RATE TIMES ASSESSED VALUE OF LAND AND DEVELOPMENTS											
SALES	FIXED STATE SALES TAX TIMES PURCHASES OF GOODS AND SERVICES											
INCOME	FEDERAL-STATE TAX											
RATE OF RETURN	NET INCOME DIVIDED BY SUM OF BUILDING VALUE AND LAND MARKET VALUE											
UNITS OF POLLUTION PER MG												
BOD (LBS/MG)	600	500	1000	500	400	800	500	6000	6000	3000	2000	100
CHLORIDES (LBS/MG)	100	100	170	150	150	200	180	400	130	380	500	0
NUTRIENTS (LBS/MG)	1000	1000	500	700	100	200	100	10000	4000	3000	8000	0
COLIFORM (PARTS/MG)	20	10	20	30	20	20	30	300	20	150	50	20
TEMPERATURE DEVIATION	9	0	6	0	0	0	0	9	18	16	4	0
OIL & FLOATING SOLIDS	1	0	1	1	0	0	0	1	1	1	1	0
HIGH LEVEL WASTES	0	0	0	0	0	0	0	0	1	1	1	0
INTAKE TREATMENT COSTS PER MG (DOLLARS)												
QUALITY OF WATER												
1	10	0	20	0	0	0	0	50	20	20	30	0
2	60	0	60	0	0	0	0	60	60	60	60	0
3	80	0	80	0	0	0	0	80	80	80	80	0
4	100	0	100	0	0	0	0	100	100	100	100	0
5	180	0	160	0	0	0	0	180	180	180	180	0
6	300	0	300	0	0	0	0	300	300	300	300	0
7	450	0	450	0	0	0	0	450	450	450	450	0
8	600	0	600	0	0	0	0	600	600	600	600	0
9	CANNOT BE USED.											
OUTFLOW TREATMENT COST PER MG (DOLLARS)												
CL	25	0	25	0	0	0	0	25	25	25	25	0
PT	100	0	100	0	0	0	0	100	100	100	100	0
ST	200	0	200	0	0	0	0	200	200	200	200	0
TT	300	0	300	0	0	0	0	300	300	300	300	0

School enrollment: the number of students attending local public schools and the number attending private schools. Students attend private schools only if the public schools in their districts are inadequate.

Housing units: the number of levels of RA (single family), RB (town house, multiple dwellings), and RC (high rise) housing.

Vacancy rate: the ratio of existing housing space to housing space occupied expressed as a percent. A negative rate means that housing is overcrowded.

Number of employed workers: the number of people holding full-time jobs, by class of worker.

Number employed by type of employer: the number of full-time workers employed by each type of business and government employer.

Number of unemployed workers: by class, the number of workers seeking full-time employment who were unable to obtain jobs.

Unemployment rate (percent): by class, the number of unemployed workers as a percent of the total number of workers who sought full-time jobs.

Earning distribution: the percent of workers earning less than $5,000, between $5,000 and $10,000, and over $10,000 from full-time employment.

Transactions with the national economy

Income from the national economy: federal-state aid received, by type of aid, and income from both basic industry sales of output and bus and rail sales of equipment.

Sales to the national economy: federal-state taxes paid, by type of tax, and purchase of goods, services, and Outside-owned land. The only Outside expenditure which can be significantly controlled locally is the purchase of goods and services due to local insufficiency.

National economy business cycle: last round's ratio to "typical income" per unit of output for basic industry, interest rates on loans and bonds from the Outside (expressed as percents), and the average rate of return on outside investments (expressed as percents).

MASTER TABLE FOR COMMERCIAL ESTABLISHMENTS
(LEVEL ONE CHARACTERISTICS)

	BG	BS	PG	PS
LOCATION REQUIREMENTS				
PERCENT OF A PARCEL CONSUMED	12	10	12	12
(MAXIMUM POSSIBLE LEVELS)	(8)	(10)	(8)	(8)
ZONING REQUIRED	0 10 30 32	0 10 30 33	0 10 30 34	0 10 30 35
MINIMUM LEVEL OF UTILITY SERVICE	2	1	1	1
(ANNUAL UTILITY UNITS CONSUMED)	112	71	99	77
CONSTRUCTION COST (MILLIONS OF DOLLARS)	25	10	30	10
DEPRECIATION				
ANNUAL PERCENTAGE (DUE TO AGING)	1.5	2.0	1.6	2.2
MS EFFECT (MAXIMUM PERCENTAGE)	2.5	3.0	2.6	3.2
FIRE (MAXIMUM PERCENTAGE)	1.5	2.0	1.6	2.2
FLOOD (MAXIMUM PERCENTAGE)				
FLOOD MULTIPLIER	1.5	1.4	1.3	1.2
USE (PERCENTAGE AT 200% USE)	1.5	2.0	1.6	2.2
WATER CONSUMPTION				
MILLIONS OF GALLONS PER DAY (MGD)	0.13	0.17	0.23	0.18
DAYS WATER IS USED PER YEAR	310	310	310	310
MILLIONS OF GALLONS PER YEAR (MGY)	40	53	71	56
EMPLOYEES				
FULL TIME POPULATION UNITS (PIS)				
PH	14	20	8	6
PM	7	9	13	11
PL	8	9	23	16
PART TIME (LEISURE TIME UNITS)				
PH	80	80	0	0
PM	0	0	80	80
PL	0	0	160	160
CAPACITY MEASURES				
MAXIMUM EMPLOYMENT EFFECT	5000	1500	16000	8000
MAXIMUM EFFECTIVE CAPACITY	5000	1500	16000	8000
NORMAL PRICE PER CAPACITY UNIT SOLD (THOUSANDS OF DOLLARS)	100	100	10	10
TYPICAL INCOME FROM SALES (MILLIONS OF DOLLARS)	500	150	160	80
EXPENDITURES				
BUSINESS GOODS (UNITS)	0.0	0.0	0.037	0.030
BUSINESS SERVICES (UNITS)	0.0	0.0	0.017	0.010
OUTSIDE SERVICE CHARGES THOUSANDS OF DOLLARS)	83	58	0	0
PURCHASES PER 1% MAINTENANCE				
BG UNITS	0.0	0.0	2.00	0.75
BS UNITS	0.0	0.0	1.00	0.25
OUTSIDE SERVICE CHARGES THOUSANDS OF DOLLARS)	250	100	0	0
TYPICAL UTILITIES COSTS (MILLIONS OF DOLLARS)	1.12	0.71	0.99	0.77
WATER (ASSUMING WATER COSTS = $450)	18135	23715	32085	25110
TRANSPORTATION (ON HWYS, PER UNIT SOLD)				
TO BG	0.0	0.0	46.25	37.50
TO BS	0.0	0.0	21.25	12.50
TO TERMINAL	1000	0	0	0
SALARIES (FULL EMPLOYMENT)	DEPENDS UPON SALARY LEVELS OFFERED			
TAXES				
PROPERTY	LOCAL RATE TIMES ASSESSED VALUE.			
SALES	FOR PG AND PS ONLY FIXED STATE SALES TAX TIMES PURCHASES OF GOODS AND SERVICES.			
INCOME	FEDERAL-STATE TAX			
RATE OF RETURN	NET INCOME DIVIDED BY SUM OF BUILDING VALUE AND LAND MARKET VALUE.			

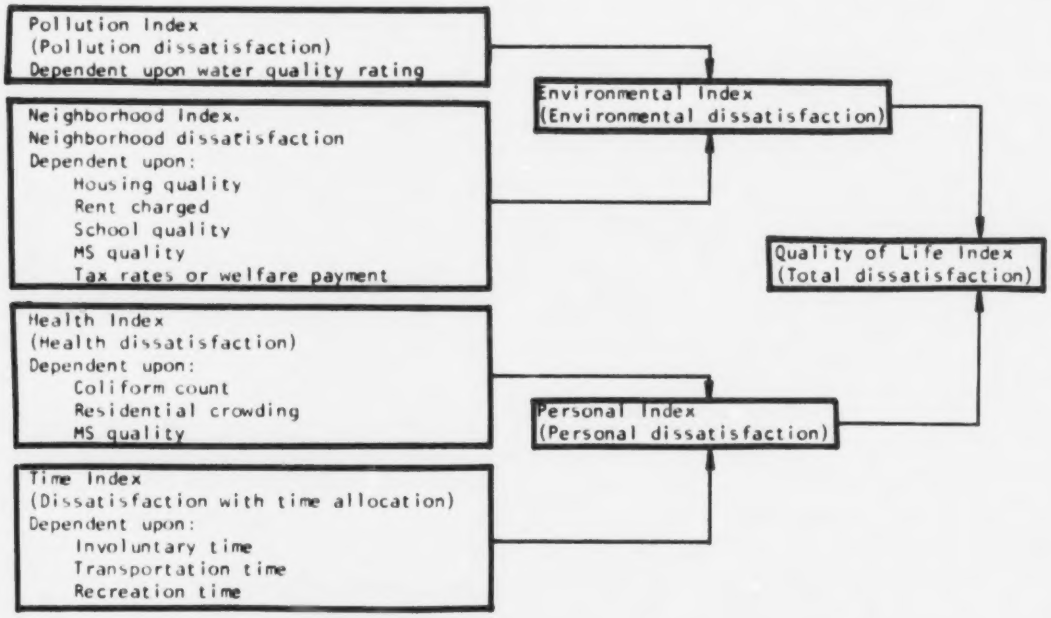
GENERAL INFORMATION

Indexes and migration

The first major computer process in each round is migration. The program moves population units within, into, and out of the simulated region in response to both local conditions and exogenous influences. The selection of which population units are moved each year and where they choose housing is entirely controlled by the computer program, although player decisions greatly affect the process.

Most of the local conditions which influence migration are expressed as indexes which are summed into the two basic indexes used in migration: environmental indexes (measures of neighborhood quality) and personal indexes (measures of personal dissatisfaction). The higher an index is, the worse the quality; a low index indicates better quality.

Components of the quality of life index


Pollution Index
(Pollution dissatisfaction)
Dependent upon water quality rating
Neighborhood Index.
Neighborhood dissatisfaction
Dependent upon:
Housing quality
Rent charged
School quality
MS quality
Tax rates or welfare payment
Health Index
(Health dissatisfaction)
Dependent upon:
Coliform count
Residential crowding
MS quality
Time Index
(Dissatisfaction with time allocation)
Dependent upon:
Involuntary time
Transportation time
Recreation time
Environmental Index
(Environmental dissatisfaction)
Personal Index
(Personal dissatisfaction)
Quality of Life Index
(Total dissatisfaction)

Indexes are relative, never being compared to a norm or even across classes, but only within classes. For example, each residence parcel has three environmental indexes, one for each class. Environmental indexes are used alone (i.e., with no other indexes added to them) only in the selection of housing. Local housing is rated for selection by movers in order of environmental indexes, with the lowest index first and the highest last. Only if there were a great demand for housing would the worst residences be chosen by movers.

The sum of a parcel's environmental index and the personal index of a class living there is that population group's "quality of life" index. The quality of life index is used to determine which population units leave their housing to find better places to live. During each round, a random half of the 20% of the population units with the highest (worst) quality-of-life indexes within each class leave their housing. All of the indexes are calculated before any people move.

Environmental indexes:

This section of output prints the value of each factor in the environmental index for each residence parcel, for each class. The parcels are listed according to where they are located on the board, the order being from left to right and top row to bottom row. The first column of this output contains the coordinates of the residence parcel for which the rest of the information in the row applies. There are three rows of information printed for each residence parcel, one row per class. The different classes weigh some of the factors in the environmental index differently.

```
********************************************************************************************
                           TWOCITY
       ENVIRONMENTAL INDEXES                                                          ROUND  2
********************************************************************************************

                                       NEIGHBORHOOD INDEX
                          ------------------------------------------------
             POLLUTION              RESIDENCE                         WELFARE               ENVIRONMENTAL
LOCATION       INDEX        CLASS    QUALITY    RENT  MS   SCHOOL   OR TAXES   TOTAL           INDEX
--------     ---------      -----   ---------   ----  --   ------   --------   -----        -------------

  9222            0         LOW          0       90   11    100        48       249              249
                            MIDDLE       0       30   11    100        26       167              167
                            HIGH         0        5   11    100        26       142              142

  9422           -7         LOW         19        0   11    100        48       178              171
                            MIDDLE      39        0   11    100        26       176              169
                            HIGH        49        0   11    100        26       186              179

  9622          -15         LOW         44        0  100     15        48       207              192
                            MIDDLE      64        0  100     15        26       205              190
                            HIGH        74        0  100     15        26       215              200

  9822           -7         LOW         19        0  100     15        48       182              175
                            MIDDLE      39        0  100     15        26       180              173
                            HIGH        49        0  100     15        26       190              183

 10022            0         LOW         14        3  100     15        48       180              180
                            MIDDLE      34        0  100     15        26       175              175
                            HIGH        44        0  100     15        26       185              185
```

The *environmental index* is the sum of the *pollution index* and the neighborhood index. The pollution index is derived from the surface water quality on a residence parcel or, if the parcel does not contain surface water, from the quality on bordering parcels. This index is the only factor in the environmental index which can be a negative number; good local water quality adds to a residence parcel's attractiveness. This index has the same value for all three classes.

The *neighborhood index* is the sum of several indexes: residence quality, rent, municipal service quality, school quality, local tax rates, and local welfare rates.

Residence quality: A residence owner determines the residence's initial quality index and its maintenance level. Residences, unlike all other constructions, can be built at a quality less than 100. A residence quality index of 50, for instance, means that the residence was either built more cheaply than residences with higher quality indexes or not maintained at a higher quality. The quality index is rated differently by the different classes, since low-income population units are not quite so demanding of highest quality as are high-income PI's. To derive the quality index for each class, the residence's quality index is subtracted from 100 for high-income, from 90 for middle-income, and from 70 for low income.

Rent: A residence owner also sets the rent charged at the residence. The different classes evaluate a residence's rent differently. The simulated region has a "typical" rent for each class (see the Master Tables on page **137** for their exact values). The typical rent is subtracted from the residence's rent and multiplied by a weighting factor. The weight for high-income is 1, for middle-income 2, and for low-income 3. Thus, a low-income group puts a greater weight on rent deviation from its typical than high-income does.

MS: The Municipal Services Department constructs and operates MS units. The quality of a municipal service unit is measured as the MS use index. An MS use index can range in value from 0 to 200. An index of 100 indicates most efficient service. An index less than 100 indicates adequate but underused capacity and an index over 100 indicates overuse of services. For the neighborhood index, 100 points are subtracted from the use index of the MS unit serving the MS district in which a residence parcel is located. If the use index is 100 or less, the factor in the neighborhood index is zero. Only a use index over 100 contributes to the neighborhood index.

School: The School Department constructs and operates school units. School quality is also measured as a use index. Again, 100 points are subtracted from the use index of the school serving the school district in which a residence parcel is located. Only a school use index over 100 contributes to the neighborhood index.

Welfare or taxes: Both welfare rates and tax rates are set by a Chairman for a whole jurisdiction, so these factors contribute to which jurisdiction a population unit selects to live in. All of the other factors in the neighborhood index are more localized, affected by conditions on individual residential parcels or individual school or MS districts.

Low-income population units consider only the welfare part of these two local government policies. For the neighborhood index for low-income, 1 point is added for each $25 which the welfare payment per unemployed worker is less than $2000. Middle and high-income groups consider only local tax rates. For the neighborhood index, one-fourth point is added for each tenth of a percent resident income, goods, and services tax rate and one-eighth of a point is added for each mil land and developments tax rate.

The last column of this output is the total environmental index, the sum of the pollution index and the neighborhood index.

Personal indexes

This output prints, for each class living on each parcel, the value of each factor in the personal index. Unlike environmental indexes, personal indexes are calculated only for classes already living on residence parcels. A population group's personal index is added to the environmental index for its class on its residence parcel. This produces the group's quality-of-life index, the relative value of which affects whether the population units will move.

```
*****************************************************************************************
                                      TWOCITY
        PERSONAL INDEXES                                                         ROUND  2
*****************************************************************************************

                        HEALTH INDEX
            --------------------------------------
                        CROWDING  BACTERIA                    TRANSP.           INVOL.   PERSONAL
LOCATION    MS EFFECT   EFFECT    EFFECT     TOTAL   CLASS     TIME     RECR.   TIME     INDEX
--------    ---------   --------  --------   -----   -----    -------   -----  ------   --------

  9222          0          0          0        0

  9422          3         25          0       28     LOW          0       0       0        28
                                                     MIDDLE      25      10      39       102
                                                     HIGH         0       0       0        28

  9622         25          0          0       25     LOW         25       3      70       123

  9822         25          0          0       25     LOW         65       3      62       155

 10022         25          0          0       25     LOW        105       3      54       187

  8824          0          0          0        0

  9424          3          0          0        3     MIDDLE      15      10      44        72
```

A class's *health index* is the sum of the values derived from three sources: municipal service quality, residential crowding, and the amount of coliform bacteria in the nearby surface water. The maximum value of the health index is 100.

MS effect: The value of the MS factor in the environmental index is divided by four for its value in the health index.

Crowding effect: A residence can be occupied up to 120% of its constructed capacity. For each percent which it is overcrowded (over 100% occupied) 1.2 points are added to the health index.

Bacteria effect: The concentration of coliform bacteria in the surface water on a parcel affects the health index of that parcel and adjoining parcels. A parcel adjoins a surface water parcel if any of its corners touches a surface water parcel's corner. The coliform count on a parcel is the highest count of all of the surface water parcels which it abuts. When used in a parcel's health index, the coliform count is divided by 4 and can have a maximum value of 50 points.

The other factors in the personal index reflect a class's time allocation and quality of public recreation facilities.

Transportation time: The time spent traveling to work is averaged for a class on a parcel for the purposes of allocating the rest of their time. Work is the only activity which population units in the same class living on the same parcel do not perform as a group. Thus, each population unit could be working at a different employment location and spending a different amount of time getting there. For each average unit of time spent in transportation to work in the previous round, five points are added to the personal index.

Recreation: Social decision-makers allocate time to recreation, and this time is subtracted from the personal index. However, the sufficiency of local parks affects the number of points which are subtracted. Park adequacy is measured in a use index like school and MS adequacy. If the use index of the most overused park within a two-parcel radius is over 100, the percent of the points subtracted from the personal index due to recreation is decreased. The number printed here is the number of points subtracted after recreation time has been adjusted for the park use index.

Involuntary time: The time which a social decision-maker allocated to various activities and which the population units were unable to spend in those activities is involuntary allocation of time.

Dissatisfaction cutoffs

A random half of the 20% of the population units in the simulated region having the highest personal indexes **(most negative)** seek housing with a lower environmental index. The top row of this output shows, by class, the personal index value above which 20% of the population falls.

A population unit with a personal index above the relevant dissatisfaction cutoff has a 50-50 chance of being selected for moving due to dissatisfaction. The rest of this output has one row per jurisdiction and one column per class showing the number of PI's of the class initially in the jurisdiction. **The right-hand column and the bottom row show totals.**

```
        DISSATISFACTION CUTOFFS

   LOW        MIDDLE       HIGH
   [illegible]   336        402

     0         128         124         252

   147          70          82         299

     0           0           0           0

   147         198         206         551
```

Migration detail

There are reasons other than dissatisfaction for which a population unit might move out of its housing. A fixed percentage of all unemployed and underemployed population units automatically leave their housing and move to the Outside system, i.e., they leave the simulated region and disappear. In addition, population units may leave overcrowded housing (housing over 120% occupied usually due to residential demolition.) Those displaced PI's seek local housing and leave the system only if they are unable to find acceptable housing. (Acceptable housing has a quality index ranging from 20 to 70 for low-income PI's, 40 to 100 for middle, and 71 to 100 for high.) Another fixed percentage of each class's population units are chosen randomly to seek better housing. These PI's, together with the PI's seeking housing because they were the most dissatisfied, leave the system if they cannot find acceptable housing with a neighborhood index below that of their previous housing.

Besides local movers, a percent of the local population in each class comes from the Outside to seek housing. This group represents natural population growth. Another group of PI's seeks local housing in response to local employment opportunities. These two types of movers leave the local system only if they cannot find acceptable housing.

```
*************************************************************************************************
                                      TWOCITY
                    MIGRATION DETAIL                                                     ROUND  2
*************************************************************************************************

                      SOCIAL    NUMBER
                     DECISION     OF                QUALITY OF   NUMBER                FROM/TO       REASON FOR
PARCEL OWNER TYPE     MAKER      PI'S     CLASS        LIFE       MOVED                PARCEL          MOVING         EMPLOYER
------ ----- ----   --------   ------     -----   ----------    ------               -------   ----------------   --------

 9222    D   RA 6

 9422    B   RA 1      C           1     MIDDLE        271            1  WENT TO     10830     DISPLACEMENT          9626

 9622    D   RA 1      D           2     LOW           315

 9822    G   RA 2      D           4     LOW           330            1  CAME FROM   10224     DISSATISFACTION       9628

10022    F   RA 4      D           9     LOW           367            1  CAME FROM   10224     DISSATISFACTION       9828
                                                                      1  CAME FROM   10224     DISSATISFACTION       9626

 9824    F   RA 6
```

The migration detail output shows, for each residence parcel, the owner, the social decision-maker controlling each class living there, the number of PI's in each class living there, after the migration process, the quality of life index for that class (this prints zero if the class was not living on the parcel in the previous round), the number of PI's who moved to or from the parcel during the migration process, where they came from or went to, their reason for moving and the location of their employer. When the location given for origin or destination of a group is zero, the group came from or went to the Outside system. New in-migrants or natural growth migrants always have employment locations of 0.

Migration statistics

```
                         MIGRATION STATISTICS

ORIGINAL POPULATION

JURIS              PL                 PM                PH
  1                 0                128               124
  2               147                 70                82
  3                 0                  0                 0

IN-MIGRATION FROM OUTSIDE SYSTEM

JURIS              PL                 PM                PH
  1                 0                  0                 2
  2                21                  2                 0
  3                 0                  0                 0
```

This output is a summary which shows, by class and jurisdiction, the original population, the number of in-migrants from the Outside system, the in-migration from other jurisdictions, the in-migration due to natural population growth, the outmigration to the Outside system, the outmigration to other jursidictions, the migration totally within each jurisdiction, and the final population. All numbers are expressed in PI's.

Migration by type

This summary output shows, by class and by jurisdiction, the number of PI's who moved for each reason from each jurisdiction (including Outside) to each other jurisdiction. Shown here is the total number of PI's from the Outside who remained Outside due to local housing insufficiency. They are indicated as having come from Outside and gone to Outside.

```
    MIGRATION BY TYPE

MIGRATION DUE TO UNEMPLOYMENT
             LOW CLASS                       MIDDLE CLASS                        HIGH CLASS
FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE     FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE    FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE
JUR-1     0     0     0     0         JUR-1     0     0     0     0        JUR-1     0     0     0     0
JUR-2     0     0     0     4         JUR-2     0     0     0     0        JUR-2     0     0     0     0
JUR-3     0     0     0     0         JUR-3     0     0     0     0        JUR-3     0     0     0     0
OUTSIDE   0     0     0     0         OUTSIDE   0     0     0     0        OUTSIDE   0     0     0     0

MIGRATION DUE TO UNDEREMPLOYMENT
             LOW CLASS                       MIDDLE CLASS                        HIGH CLASS
FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE     FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE    FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE
JUR-1     0     0     0     0         JUR-1     0     0     0     2        JUR-1     0     0     0     2
JUR-2     0     0     0     0         JUR-2     0     0     0     3        JUR-2     0     0     0     1
JUR-3     0     0     0     0         JUR-3     0     0     0     0        JUR-3     0     0     0     0
OUTSIDE   0     0     0     0         OUTSIDE   0     0     0     0        OUTSIDE   0     0     0     0

MIGRATION DUE TO MOBILITY
             LOW CLASS                       MIDDLE CLASS                        HIGH CLASS
FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE     FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE    FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE
JUR-1     0     0     0     0         JUR-1     0     4     0     0        JUR-1     4     1     0     0
JUR-2     0     0     0     0         JUR-2     0     1     0     0        JUR-2     2     1     0     0
JUR-3     0     0     0     0         JUR-3     0     0     0     0        JUR-3     0     0     0     0
OUTSIDE   0     0     0     0         OUTSIDE   0     0     0     0        OUTSIDE   0     0     0     0

MIGRATION DUE TO PERSONAL DISSAT.
             LOW CLASS                       MIDDLE CLASS                        HIGH CLASS
FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE     FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE    FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE
JUR-1     0     0     0     0         JUR-1     5     5     0     0        JUR-1     0    11     0     0
JUR-2     0     5     0     0         JUR-2     0     5     0     0        JUR-2     0     6     0     0
JUR-3     0     0     0     0         JUR-3     0     0     0     0        JUR-3     0     0     0     0
OUTSIDE   0     0     0     0         OUTSIDE   0     0     0     0        OUTSIDE   0     0     0     0

MIGRATION DUE TO DISPLACEMENT
             LOW CLASS                       MIDDLE CLASS                        HIGH CLASS
FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE     FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE    FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE
JUR-1     0     0     0     0         JUR-1     0     6     0     0        JUR-1     5     2     0     0
JUR-2     1     3     0     2         JUR-2     6     3     0     0        JUR-2     3     6     0     0
JUR-3     0     0     0     0         JUR-3     0     0     0     0        JUR-3     0     0     0     0
OUTSIDE   0     0     0     0         OUTSIDE   0     0     0     0        OUTSIDE   0     0     0     0

MIGRATION DUE TO NATURAL GROWTH
             LOW CLASS                       MIDDLE CLASS                        HIGH CLASS
FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE     FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE    FROM/TO JUR-1 JUR-2 JUR-3 OUTSIDE
JUR-1     0     0     0     0         JUR-1     0     0     0     0        JUR-1     0     0     0     0
```

Water system output

Water effluent content

Economic activities, municipal sewer systems and farms dump effluent into the surface water. All businesses except surface water users dump their effluent into municipal systems, which then can treat some or all of the effluent. This section of the output shows in detail the pollution generated by each farm and economic activity. If a basic industry has a treatment plant, the amount of pollution printed is the pollution remaining in the effluent after treatment. Industries can recycle some water (up to 100%), which decreases the amount of water in the effluent but not the amount of pollution in the effluent.

The amount of each pollutant is expressed on this output as 100 times its actual value. The pollution here is not measured in its concentration per MGD, as it is measured at sampling stations. The pollution is a total volume of pollutant in the effluent. The amount of effluent is also expressed as 100 times its actual value.

```
**************************************************************************************************************
                                                  FACILITY
                                      WATER USER EFFLUENT CONTENT                                     ROUND  2
**************************************************************************************************************

           TYPE    TREATMENT                                                                       OIL AND   HIGH    WATER
           AND     TYPE AND    PERCENT     BOD       CHLORIDES    NUTRIENTS   COLIFORM  TEMPERATURE FLOATING  LEVEL   DUMPED
LOCATION   LEVEL   LEVEL       RECYCLED    (X 100)   (X 100)      (X 100)     (X 100)   (X 100)     SOLIDS    WASTES  (MGDX100)
--------   -----   ---------   --------    -------   ---------    ---------   --------  ----------- --------  ------  ---------

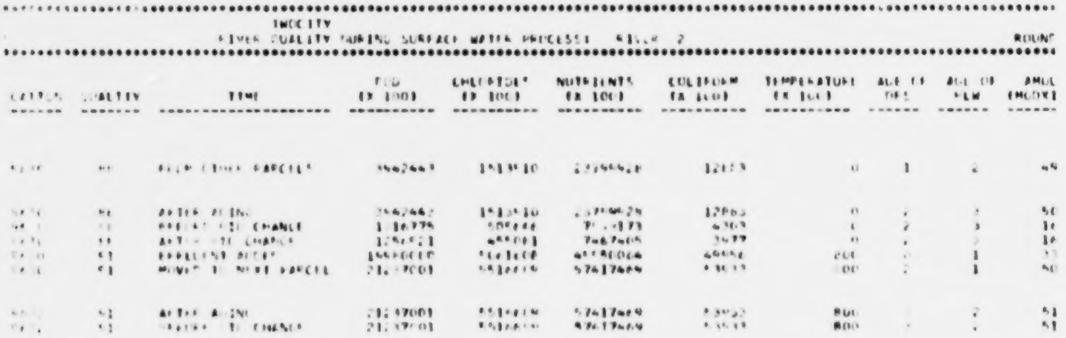
[illegible] F  2
[illegible] F  2        0          0           0          0            0           0          0        0         0       2000
[illegible] F  2
[illegible] F  2        0          0           0          0            0           0          0        0         0       2000
[illegible] F  2
[illegible] F  2        0          0           0          0            0           0          0        0         0       2000
[illegible] F  2
[illegible] F  2        0          0           0          0            0           0          0        0         0       2000
[illegible] F  2
[illegible] F  2        0          0           0          0            0           0          0        0         0       2000
[illegible] F  2
[illegible] F  2        0          0           0          0            0           0          0        0         0       2000
[illegible] MA [illegible] 0       0           0          0            0           0          0        0         0          0
[illegible] MA 1        0          0        7700        250          540          35          0        1         0          7
[illegible] MA 1        0          0        6000        180          820          30          0        1         0          6
[illegible] MA 2        0          0       12000        360          860          60          0        1         0         12
[illegible] MA [illegible] 0       0       27000        810         1440         135          0        1         0         27
```

Oil, floating solids and high-level wastes are represented somewhat differently from the other pollutants. They are either present in the effluent or not. They are not measured in volume or concentration. A zero indicates that the pollutant is absent, and a one indicates that the pollutant is present.

For a farm parcel, two rows are printed. The first shows the location of the farm parcel and its type. The second shows the location of the parcel on which the farm's runoff flows, the type of farm dumping on that parcel, and the volume of pollutants and water being dumped there.

River quality during surface water process

This output shows the amount of pollution present on a parcel during all stages of the surface water process. (A surface water parcel is part of a river.) The parcels are listed in the order in which they are processed, i.e., in sequential order upstream-to-downstream for each river. The water quality is expressed by a two-digit code, the first digit of which represents the water quality category and the second of which represents the first pollutant type which placed the water quality in that category (1=BOD, 2=Chlorides, etc.)



The values printed for the last two pollutant types, oil and floating solids and high level wastes, are their "ages". Each of these pollutants disappears from the river water after travelling five parcels down the river. Whenever two rivers meet or effluent is dumped into the surface water, the "age" of that pollutant in the surface water becomes the "age" of the youngest source of that pollutant.

For each parcel, the pollutant content of the water is given for five different stages. The first, *After aging*, shows no difference in pollutant content from the previous parcel except for the ages of oil and floating solids and high level wastes. The volume of water is the volume of surface water on the parcel.

Before bio change is the amount of pollution in the surface water after water has been removed by any intake on the parcel. When water is removed from a parcel, the pollution in that water is also removed. So, if one third of the water on a parcel were removed, one third of the pollution would also be removed. Only oil and floating solids and high level wastes are unaffected when water is removed. The volume of water printed on this line is the volume remaining in the surface water after any water is removed.

After water is removed from the surface water, the remaining pollution undergoes a biodegradation process. The third line, *After bio change*, shows the amount of pollution in the river after that decay process.

Water is dumped on parcels containing municipal outflow points, basic industry surface water users, and agricultural runoff points. The total amount of pollution added to the surface water on a parcel is the fourth line, *effluent added*. That pollution is added together with the pollution remaining in the river after biodegradation, and the result is moved to the next parcel in the river. The total amount of pollution leaving a parcel is shown on the fifth line, *Moved to next parcel.*

For those parcels on which municipal intake points are located, the program prints the utility district code number and amount of water removed by the district on a line between *After aging* and *Before bio change*. The amount of water printed is shown as 100 time its actual value.

Water-user costs and consumption

All water users except farms can incur differing costs related to water. Prices paid by municipal water users purchasing locally are set by jurisdiction and by type of water. One cost for use of water can be incurred if a user cannot obtain all of the water necessary from the normal source. The user must then automatically purchase the remainder from the Outside at the Outside price. The Outside price represents a higher cost to a water user to obtain or process the required water. Regardless of how a business obtains its water requirement, it dumps all of its effluent into a municipal system or, if it is a surface water user, into the surface water on its parcel

```
*********************************************************************************************************************************
                                                        FACILITY
                                     WATER USER COSTS AND CONSUMPTION                                                   ROUND  4
*********************************************************************************************************************************

              TYPE                                AMOUNT     AMOUNT       ANNUAL        ANNUAL                  INTAKE     OUTFLOW
              AND                    UTILITY     REQUIRED   OBTAINED    CONSUMPTION     WATER      RECYCLING   TREATMENT  TREATMENT
LOCATION     LEVEL    JURISDICTION   DISTRICT     (MGD)      (MGD)         (MG)         COST        COST        COST       COST
--------     -----    ------------   --------   --------   --------    -----------   ---------   ---------   ---------  ---------

 [illegible]   [illegible]    1          1          0.0        0.0            0             0           0           0          0
 [illegible]   [illegible]    1          1          0.07       0.0           25         17640           0           0          0
 [illegible]   [illegible]    2          2          0.06       0.06          21          9720           0           0          0
 [illegible]   [illegible]    2          2          0.12       0.12          43         19440           0           0          0
 10022         [illegible]    2          2          0.27       0.27          97         43740           0           0          0
 [illegible]   [illegible]    1          1          0.0        0.0            0             0           0           0          0
 [illegible]   [illegible]    1          1          0.07       0.0           25         17640           0           0          0
 [illegible]   [illegible]    2          2          0.87       0.87         313        140940           0           0          0
 [illegible]   [illegible]    2          2          1.29       1.29         464        208980           0           0          0
 [illegible]   [illegible]    2          2          0.42       0.42         151         68040           0           0          0
 [illegible]   [illegible]    2          2          0.27       0.27          97         43740           0           0          0
 [illegible]   [illegible]    1          1          0.28       0.0          100         70560           0           0          0
 [illegible]   [illegible]    1          1          0.28       0.0          100         70560           0           0          0
 [illegible]   [illegible]    1          1          0.31       0.0          111         78120           0           0          0
 [illegible]   [illegible]    1          1          [illegible] 0.0          75         52920           0           0          0
```

A municipal water user obtains all of its needed water from the municipal system unless: (1) the total amount of water attempted to be removed by surface water users (municipal intake points or surface water using basic industries) from the parcel on which its municipal intake point is located is greater then the amount of water on the parcel; (2) the water quality on the municipal intake parcel is 9; (3) the intake treatment plant of its municipal system has the capacity to process less than the total water requirement. In the second case, no water users supplied by the municipal system receive municipal water; all purchase from the Outside. In the first and third cases each water user receives a share of the municipally-supplied water proportionate to its needs. If both the first and third cases exist, the lesser amount is removed from the surface water and treated. A business pays the local price set for its business type for that proportion of its annual requirement which is supplied locally, and pays the Outside price for the rest.

Surface water users obtain all of their needed water from the surface water unless: (1) the surface water quality is 9; or (2) the total amount of water demanded of the parcel is greater than the amount of water on the parcel. In the first case, the industry buys all of its water from the Outside at the Outside price. In the second case, the industry receives from the surface water an amount proportionate to its requirement, and buys the remainder from the Outside.

On this output, the number printed under *Amount required* is the water user's daily water requirement. The *amount obtained* is the amount of water obtained from the water user's normal source of water. The *annual consumption* is a function of the activity's type, level, and, in the case of basic industries, amount of recycling. The *annual water cost* is the total cost which the activity pays for water in that round. A surface-water user who obtains all water from the surface water has zero cost.

Only basic industries can subject their surface water to recycling, intake treatment, and outflow treatment. A business's recycling cost is a function of its amount of recycling and its normal water requirement. Its intake treatment cost has an additional variation for the quality of the intake water. Outflow treatment costs vary by the industry's volume of effluent and the type of treatment provided. All three costs are shown on this output as total annual costs.

Coliform and pollution index values (map)

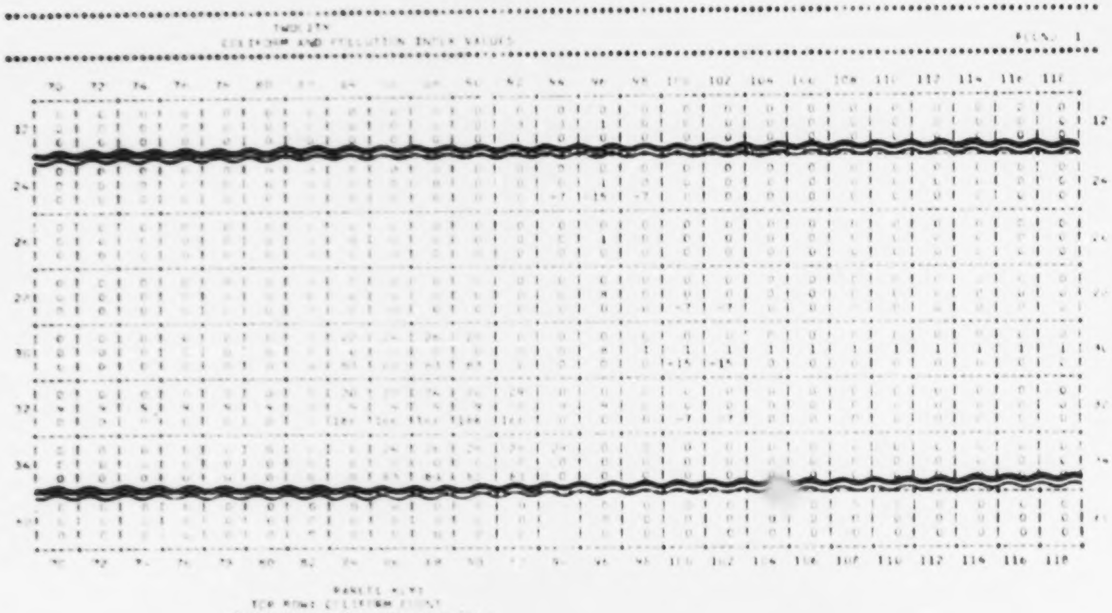
The coliform concentration in the surface water on a parcel affects the health index of that parcel and of adjoining parcels. A parcel adjoins a surface water parcel if any of its corners touches a surface water parcel's corner. The coliform count on a parcel which adjoins a surface water parcel is the highest count of all of the surface water parcels which it adjoins.

A parcel's pollution index contributes to its environmental index. It can be negative; good water quality contributes to the desirability of both surface water parcels and bordering parcels. For a parcel containing surface water, the pollution index is:

$$(W-3.5)^3$$

where W is the surface water quality rating.

The pollution index of a parcel bordering a surface water parcel on a full side is half of the average pollution indexes of the surface water parcels which it borders. Pollution indexes are calculated for lake parcels and parcels bordering lake parcels. Since the concentration of individual pollutants is never specified for lake parcels, there are no coliform counts for them.



COLIFORM AND POLLUTION INDEX VALUES

PARCEL KEY
TOP ROW: COLIFORM COUNT
MIDDLE ROW: WATER QUALITY RATING
BOTTOM ROW: POLLUTION INDEX

Employment output

The full-time employment and transportation processes

The employment allocation process is run soon after the migration process. unlike the migration process, the employment process operates on all PI's; each PI reconsiders all job openings each round. A whole PI is hired at a time; there is no smaller unit in employment than a PI, which is composed of many workers.

The factors involved in the matching of workers with jobs are: each employer's salary offerings (salaries are set by class, one salary offered to each class by each employer), the transportation costs for workers to get to employment locations, the worker's relative education levels, the number of job openings in each class, where workers were employed in the previous round, and where workers are boycotting job openings. In general, if there are fewer workers than jobs, those employers offering the lowest salaries or located farthest from residences do not receive all of their needed employees and suffer production losses. Likewise, if there are more workers than jobs, those workers with the lowest education levels or located farthest from jobs are unable to find employment.

The process operates on one class at a time, high-income first and low-income last. Any high-income workers who cannot find jobs are first to be considered for middle-income jobs, and any middle-income workers who cannot find middle-income jobs are the first to be considered for low-income jobs. Thus, unemployment tends to be pushed toward the lower classes, although that is not always the case.

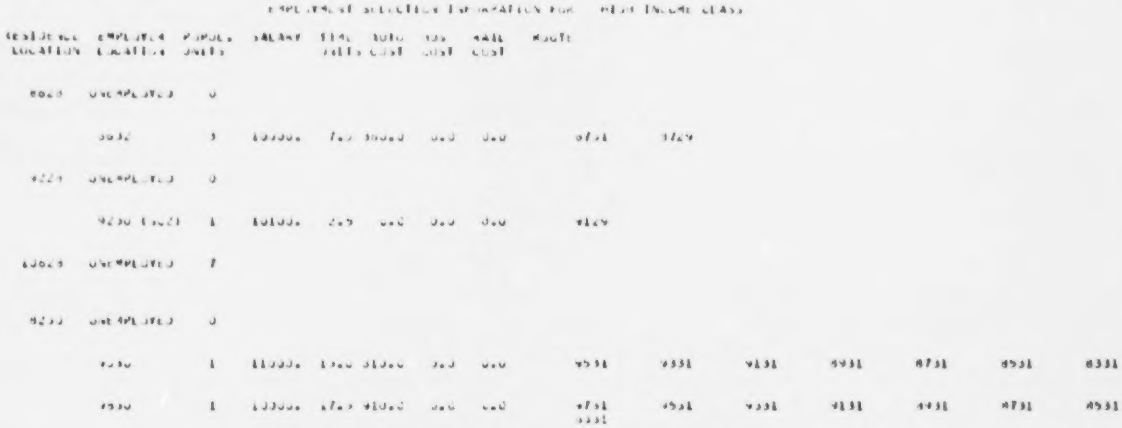
The first part of the employment process is the selection of the least-cost route from each class living on a residence parcel to each employment location. When a population group selects a least-cost route, it evaluates both the time (dollar value of time), and actual dollar cost of each mode and route. Mode of travel is also a factor, since overcrowded modal usage causes delays in time. Each class is willing to pay up to a fixed percent of the income which it would earn at a job in order to get to the job.

After the least-cost route has been selected, each PI applies for the job which nets it the greatest amount of money (salary less transportation cost). A PI does not even consider taking a job which it is boycotting. A PI perceives a somewhat higher salary at its previous job than is actually offered there. If the net income which the PI would receive at its old job is perceived to be highest, the PI takes its old job back and looks no further. The remaining PI's seeking employment compete for jobs on the basis of their educational levels. An employer selects applicants with the highest education levels first. Those PI's who are not hired for their best jobs then seek employment at their next best jobs. The process is repeated until either all of the job openings in the class have been filled or all of the PI's in the class have been hired. There is one type of exception to the latter case: a PI which cannot find a job within its maximum transportation range remains unemployed.

After the employment process has been run for all three classes, transportation routes and congestion are recalculated using the origins and destinations created in the employment process. All classes are assigned simultaneously to the least cost routes in time and money from their residences to their jobs, considering the previous round's usage of modes and routes. If there are any great changes in congestion between rounds after all have been assigned routes, the transportation process is run again, considering the new usage. The process is repeated until there is no great change in congestion between two successive iterations. PI's pay only the final actual dollar cost to travel; the time dollar cost is used for route allocation only.

The full-time employment and transportation output

Detailed employment information prints for each class, low-income first and high-income last. Within a single class's output, all of the information pertaining to those of the class living on the same residence parcel is printed together.



The first column contains the coordinates of the residence parcel. The next column contains the location of each employer for which PI's in the class on the parcel work. The first row shows the number of PI's who are unemployed on the parcel. For each other row, the output shows the number of PI's working at the employment location, the salary earned per worker, the total number of time units spent traveling to work, the total automobile, bus, and rail costs paid per worker, and the route and modes which the population units take to work. The route printed is traced from employment location to residence location through the intersections representing the start of travel, intersections passed, intersection at which a new mode is used, and the last (residence) intersection. An intersection number may be preceded by a bus or rail route number if the PI got off the bus or rail system at that intersection.

Next to some employment location parcels are parentheses containing the name of a government department or the notation 'FSE'. That parcel does not necessarily have government activity on it. It is merely used as a central hiring location because, although a department can have facilities on several parcels, it hires centrally as a whole. The letters 'FSE' denote Federal-state employment, and is a catch-all category for miscellaneous local employment. An FSE only hires; it has none of the other characteristics of a business or local government department.

The part-time employment process

A social decision-maker can allocate time units for his population units to spend in part-time work, although there is seldom enough extra work for all the time allocated. As with the full-time employment allocation process, the PI's educational level is the most important factor in the assignment of part-time work.

The supply of part-time work units, eighty of which are equivalent to one full-time job, is primarily determined by the levels of business activity in the system. Each business type has a fixed number of time units of part-time work for each class for each level of operation. In addition, a variable number of part-time work units (jobs) is provided by the School Department.

Two lists -- one *supply of* and the other *demand for* part-time work units -- are created for each population class. The suppliers of part-time work units are ordered by the salary offered (proportional to full-time wage offered) with the highest salary placed first. Each entry on this list contains a location, a full-time salary per worker, and an amount of part-time work units available.

Each entry in the *demand-for-units* list is comprised of a residence group which allowed time for extra work, an average education level, and an average time allocation for extra work. Each PI of the same class living on the same parcel has averaged, and thus identical, characteristics such as education level and time allocated for extra work. This list is ordered on the basis of average education level with the highest levels first.

For each complete pass through the list of residence groups, the part-time work allocation process attempts to assign by class ten units of extra work to each population unit which has an unfilled extra work allocation. The process continues until either all requests (unfilled allocations) are filled or until the supply of part-time work units is exhausted.

Once a request is determined, the job supply list is examined. For each potential work location, a "shadow" automobile transportation cost per worker is calculated. This value is subtracted from the salary per worker to obtain a net income per worker which is then used to determine the best job. Units from this best job are assigned to the residence group up to the amount of their request. If that particular job has an insufficient supply of part-time units available, the remainder of the request must be met by the second-best job, and so on.

After the job units are assigned to the particular residence group, their per-PI unfilled extra work time allocation units are decremented by ten (or the figure less than ten) and they are placed at the bottom of the residence group list. Subsequently, a different residence group appears at the top of the list and the assignment process proceeds in the identical fashion. High-income population units may not be assigned middle or low-income part-time jobs, nor may middle take low or high, and so forth. Within an income class, the only case in which a PI would receive a part-time job before another PI with a higher education level is the case in which the latter's transportation cost exceeded the remuneration expected from the particular job.

The part-time employment output

One output is printed for each class. The first column shows the coordinates of the residence parcel. The second shows the location of one employer for whom the class on the parcel has been assigned part-time work. (The location ADEC indicates that the class is working for a School Department's adult education program.) The third column is the total number of part-time work units which the class on the parcel is filling at the employment location. The fourth contains the full-time salary offered per worker at the employment location. Since a full-time job is equivalent to 80 time units in part-time work, a class which filled 60 time units at a particular employer would receive 60/80 of the total salary.

```
PART-TIME WORK ALLOCATIONS FOR MIDDLE
INCOME CLASS
RESIDENCE  EMPLOYER  TIME UNITS SALARY
--------------------------------------

  6830       9432       40      5500.
  5330       9230       30      5200.
  9424       9332       10      5500.
  9223       9230       10      5200.
 10332       9332      150      5500.
 10032       9430       40      5100.
 10232       9430       30      5100.
  9422       9430       10      5100.
  9032       9230       60      5200.
  9032       9430       20      5100.
  9034       8432       40      5000.
```

Employment summary

```
                                        EMPLOYMENT SUMMARY


                                  LOW INCOME     MIDDLE INCOME       HIGH INCOME        ALL CLASSES

NUMBER OF RESIDENCES                  13               28                27                 68
PI'S EMPLOYED AT THIS LEVEL          121              144               231                496
PI'S EMPLOYED AT LOWER LEVEL           0                4                 0                  4
PI'S UNEMPLOYED                       51                0                 7                 58
TOTAL POPULATION UNITS               172              148               204                564
PART-TIME UNITS WORKED               633              732              1270               2635

NUMBER OF JOBS STILL AVAILABLE       114               33                52                199
```

This output is the single most useful section of the employment output for an observer to use in quickly evaluating the local employment situation. It includes the following summary information for each class: the number of residence parcels occupied; the number of PI's employed in jobs of their own class; the number of PI's taking jobs in the next lower class; the number of unemployed PI's; the total number of PI's in the class living in the simulated region; the total number of part-time units worked by the class; and the number of job openings for the class which were left unfilled.

Employment centers

This output lists information concerning Federal-state employers and the locations of local government employment centers. The director specifies where Federal-state employers are located, how many PI's they attempt to hire, and the salaries they offer. This output shows that information and the number of jobs which were actually filled at each Federal-state employment location.

The director can also designate locations from which a local government department hires. If the director does not designate a parcel as a department's employment center, that department has the whole region as its hiring location. In that case, an employee's transportation time and dollar cost is the equivalent of two parcel sides transversed on a type 2 road. He does not contribute to road usage.

```
*************************************************************************
                              TWICITY
                         EMPLOYMENT CENTERS
*************************************************************************
 FEDERAL STATE EMPLOYERS
 -----------------------

 EMPLOYER        JOB OPENINGS               JOBS FILLED              SALARY OFFERED
 LOCATION    LOW  MIDDLE  HIGH        LOW  MIDDLE  HIGH        LOW  MIDDLE  HIGH
 --------    ---  ------  ----        ---  ------  ----        ---  ------  ----

  [illegible]  [illegible]  [illegible]  [illegible]     0      4      5        2600   4200  10400
 LOCAL GOVERNMENT EMPLOYERS
 --------------------------
 [illegible]      EMPLOYMENT CENTER
 ---------------  -----------------
   [illegible]        [illegible]
   [illegible]        [illegible]
   [illegible]        [illegible]
   [illegible]        [illegible]
   [illegible]        [illegible]
   [illegible]        [illegible]
```

Commercial output

The commercial allocation process

All people and businesses and two government departments purchase goods and services each round in order to function. People and residence owners purchase from personal goods (PG) and personal services (PS) establishments. Businesses, schools, and municipal services purchase from business goods (BG) and business services (BS) establishments. The computer program performs the process of allocating PG, PS, BG and BS buyers to sellers, but is affected by player decisions.

Each user of goods and services requires a certain number of consumption units. A consumption unit represents a quantity to be purchased, regardless of what items comprise that quantity. The quantity of goods or services which a seller can provide is also expressed as a certain number of consumption units. Each seller of goods or services sets a price which must be paid for each consumption unit purchased at his commercial establishment. Usually PG and PS prices are similar and BG and BS prices are similar. The quantity which each buyer must obtain is indirectly derived from player decisions by the computer program. The program relates the local supply to that demand obtained by simulating the decision of each buyer as to where to purchase required goods and services. The PG-PS allocation process is run before the BG-BS allocation process. A description of PG allocation suffices as a PS description, since the processes are identical.

The buyers of PG are each class living on each residence parcel and each residence unit incurring maintenance. All of the same class living on the same residence parcel purchases at the same PG; a residence owner buys all of a single residence parcel's maintenance needs at the same PG source.

Each buyer of PG attempts to purchase from the PG establishment at which it can obtain goods most cheaply. The buyer's cost per consumption unit (CU) is the establishment's price plus the transportation cost per CU to get from the buyer's location to the establishment. There are two additional factors in a buyer's perception of a seller's price. One is the buyer's bias toward shopping where it shopped in the previous round. The other is the buyer's bias against shopping at an establishment which was overused in the previous round, i.e., an establishment at which more CU's were sold than the establishment could adequately provide. There is no absolute limit on the amount which a PG can sell, but as it sells more than its effective capacity to provide, its service deteriorates.

Each buyer selects the PG establishment at which it incurs the least perceived total cost. A buyer does not even consider selecting a PG which it is boycotting. All buyers choose simultaneously, and then reevaluate their selections in light of the new usage. The evaluation process is repeated until no commercial establishment changes its usage on two successive reevaluations.

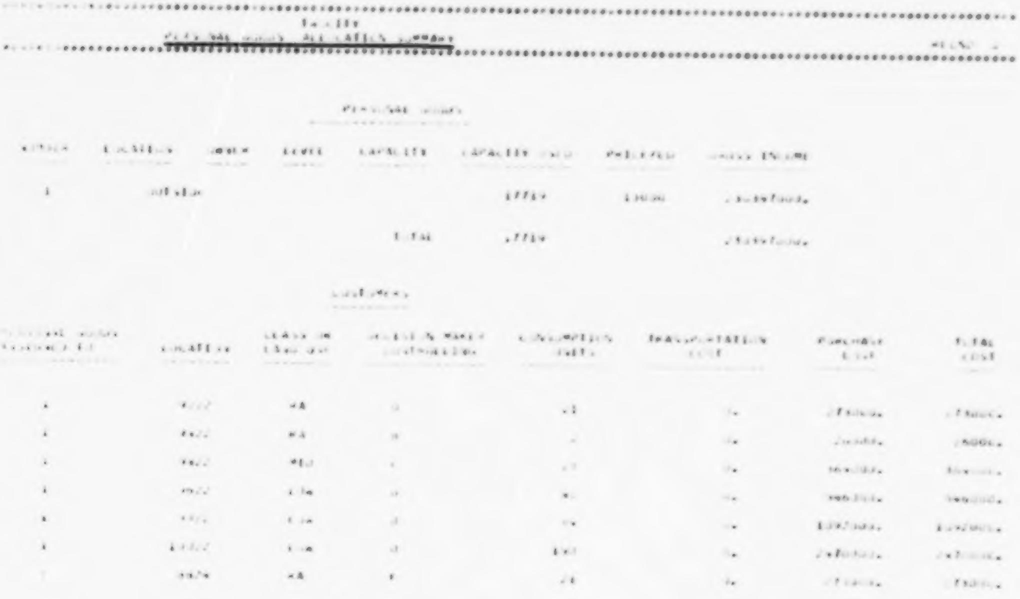
There is one competitor for local PG establishments: the Outside. The Outside is treated the same as any other PG in the allocation process, but its price is higher than the typical local price (see Master Tables, page 136, for Outside prices and typical local prices). There is, however, no transportation cost to shop Outside. A PG buyer purchases Outside if the Outside price is less than its least perceived local cost to shop. The Outside has unlimited capacity.

There are four main parts to the commercial output:

Personal goods allocation summary
Personal services allocation summary
Business goods allocation summary
Business services allocation summary

The following output descriptions will emphasize PG, but the processes outlined are, to a great extent, identical.

The first section concerns PG establishments. Each PG has a code number. The Outside is always code number one. In the row beside the code number are the location of the PG, its owner, development level, effective capacity (in CU's), the number of CU's sold, the price charged per CU, and the PG's gross income. The Outside has no owner, level, or capacity.



The second section provides detail on all purchases of PG. The table contains one row for each purchaser of PG. The list is ordered by residence parcel location, from left to right and top to bottom across the board. For a single parcel, the list is in order of residence, low-income, middle-income, high-income. The first column contains the code number of the PG at which the buyer is shopping. The second column contains the coordinates of the residence parcel and the third identifies the type of buyer on the residence parcel (*RA*, *RB*, *RC*, *Low*, *MID*, or *HIGH*). Next is a single letter identifying the decision-maker controlling the residence or class. For a residence, the letter denotes an economic decision-maker; for a class, the letter denotes a social decision-maker.

The number of consumption units which the buyer has obtained is the fifth item of information. The number of CU's required is calculated by the program but is affected by player decisions. The calculations are different for residential maintenance than for PI's. A residence depreciates each round in response to several factors: normal depreciation (fixed), quality of local municipal services, sufficiency of local water for fire protection, and floods. Only the normal depreciation is not responsive to local conditions. A residence owner can offset depreciation by setting a maintenance level for the residence. When the residence depreciates below that maintenance level, the program automatically calculates the number of PG and PS units required to restore the residence to the maintenance level. The values of the factors which affect depreciation and the number of PG and PS units required are shown on the Master Tables (page **137**). For example, suppose that an RB had a quality index of 70 and a maintenance level of 70, and that the Master Table showed that RB requires 4 PG units and 2 PS units per 1% maintenance. Suppose that the residence depreciated a total of 3% (3% of 100, not of 70). The RB would automatically purchase 3 × 4, or 12 units of PG, and 3 × 2, or 6 units of PS.

The total consumption of a class living on a single residence parcel is a function of three things: the class, the amount of time allocated to recreation, and the number of PI's in the class living there. The fixed number of PG and PS units required by a PI in each class are shown on the Master Table (page **93**). The amount of time allocated to recreation is set by the decision-maker controlling the class on the parcel. The Master Table (page **93**) shows the number of PG and PS units which a PI must purchase for each time unit spent in recreation. For instance, suppose that there are 6 PM's on a parcel and that they have allocated 10 time units to recreation. Suppose further that the Master Table shows that a PM requires 28 PG and 11 PS units per round, and .05 PG and .05 PS units per time unit in recreation. The 6 Pm's would require

28 × (10 × .05) × 6 = 84 PG units, and 11 × (10 × .05) × = 33 PS units.

The transportation cost, the sixth column, is the total transportation cost which the buyer pays to obtain PG. The transportation cost is zero if the buyer purchases from the Outside. The transportation costs printed for economic teams owning residences are dummy costs used for the purposes of assigning residential maintenance purchases to PG establishments; no one ever pays that cost.

The last two columns show the total purchase cost paid by the buyer to the PG establishment and the total cost paid by PI's for the personal goods and transportation (columns six plus seven).

The *Personal services allocation summary* contains the identical types of information regarding detail on buyers and sellers of personal services.

The *Business Goods* and *Business Services* summaries are also identical regarding economic sector buyers and sellers, with a few minor exceptions. For one, PG and PS suppliers buy from BG and BS in response to their sales resulting from the personal commercial allocation. The Master Table (page **136**) shows how many units of BG and BS a PG or PS must purchase for each CU which it sells.

A basic industry requires a fixed number of BG and BS units each round. The fixed number is the number which the Master Table (page **135**) shows as being required for a "level one" of the industry type. That amount times the industry's level is the industry's fixed consumption.

Businesses depreciate annually due to several factors. Like residences, businesses may offset depreciation through maintenance. The Master Table (page **138**) shows the number of BG and BS units required per 1% maintenance for each business type. Business Goods and Business Services are the only business types which never pay for operating costs and maintenance costs locally. They always purchase from the Outside.

The major difference between the BG-BS and PG-PS allocation processes is that BG and BS can have contracts to provide local schools and municipal services departments with their required goods and services.

```
                                  GOVERNMENT CONTRACTS
                                  ____________________

BUSINESS GOODS            DEPARTMENT              CONSUMPTION UNITS              COST
--------------            ----------              -----------------              ----


      1                      MS1                                22            2860000
      1                      SC1                                 8            1040000
```

A department can contract with several local goods and services establishments for up to a total of 100% of its requirement. If less than 100% of a department's requirement is contracted locally, then the rest is automatically purchased from Outside at the Outside price. Government contracts with BG and BS establishments are made by players; they enter into the commercial allocation process only in that they consume BG and BS and thus decrease a BG's or BS's remaining capacity before the other BG-BS buyers select shopping locations. Sellers to the government are assured of government purchases. The number of units which a department consumes is the sum of the operating needs of its facilities (number of levels times a fixed requirement per level) and its maintenance requirements. Both BG and BS allocation summary outputs have a table showing where government departments are buying BG and BS, how many units are consumed by each department, and the total income to the BG or BS establishment for those sales.

Terminal allocation output

Heavy industries, light industries, and business goods producers all use terminals. Terminals represent major shipping and receiving points through which those businesses interact with the Outside system

A business is assigned by the program to the terminal to which it has the least transportation cost. However, terminals have capacities, and a terminal's usage affects a business's perception of the transportation costs involved. The allocation process is similar to the commercial process in that terminal users are assigned to terminals simultaneously and then reevaluate their choices in light of the new allocation. However, there is no Outside terminal. Since the only cost to a terminal user is the transportation cost, it uses the terminal to which the transportation cost, weighted by its usage, is least. The user pays only the actual transportation cost.

```
CUSTOMERS
LOCATION LAND USE REQUIREMENT
9230          PA        3000
9630          PA        3000
9530          HI         700
9432          FI        3000
9032          HP        6000
9232          LR        3000
9032          PA        3000
9032          PA        3000
9432          LR        3000

TERMINALS
NUMBER  LOCATION  LEVEL

   1      9531      2
```

The terminal output lists the location of each terminal user, the type of economic activity, and the number of terminal capacity units consumed by the user. It also shows, for each terminal, the terminal's code number, its location (terminals are located at intersections), and its development level. The capacity of a "level one" terminal is shown on the Master Table (page 288). A terminal's capacity is its development level times the capacity of a level one terminal.

The terminal allocation map

The terminal output also includes a map showing the geographic distribution of terminal users and terminals. Each parcel on the map contains a single digit, which, if non-zero, is the code number of the terminal which the economic activity on that parcel is using. Terminals are identified by their single-digit codes, are located at intersections, and are surrounded by asterisks.

```
        TERMINAL ALLOCATION MAP

       70  72  74  76  78  80  82  84  86  88  90  92  94  96  98 100 102

        0   0   0   0   0   0   0   0   0   0   0   0   1   0   1   0   0
   30   0   0   0   0   0   0   0   0   0   0   0   0   0   1   1   0   0
                                                             *1*
   32   0   0   0   0   0   0   0   0   0   0   0   0   1   1   0   0   0
   34   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
   36   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
   38   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
```

THE SOCIAL SECTOR

The Social Sector teams are given the responsibility for determining how the local population will act. They should use this power in such a way as to satisfy self-established goals and/or to respond to pressures put upon them by the government sector, landlords, employers, and the business community. In a sense, the decision-makers in the Social Sector do more than represent the people - they are the people. To fulfill this position, social sector participants make the continuing decisions related to the people's financial status, the allocation of time, the degree of political interaction with other groups, boycotts, strikes and even civil disobedience.

In addition, the periodic control of power comes to the Social Sector in the election process. This sector has a balance of voting power and makes the vote decisions on elected officials, all public referenda (including bond issues), and public laws.

As in the real world, the Social Sector participants often have the feeling of impotence because of their very limited economic assets and the frequent indifference of the government toward them. It is possible, however, for the Social Sector to have an impact on both the processes of government and the development of the region. This requires making the maximum use of the information available, a persistent and determined interaction with other sector decision-makers, and the development and pursuit of well-conceived strategies.

It is important for social decision-makers to gain a good understanding of their options in the model and then bring their own ideas and concepts to bear quite early by going beyond the mechanics of their roles.

Dollar value of time

The social sector has four types of resources: time, voting power, money, and the power to boycott or strike. The first two are unique to this sector, and it is through time allocation that social decision-makers can increase their voting strength. Time can be allocated to extra work, adult education, politics and recreation. Time is not specificcally allocated to transportation, but transportation makes the first claim on allocatable time. It decreases time available for other activities. A decision-maker or the director can affect the amount of time (i.e., transportation mode) which PI's spend travelling through the decision to specify the dollar value of a time unit.

The computer assigns all population units to modes of transportation to and from work on the basis of least cost. Least cost includes transportation charges (which differ according to mode of transportation, type of road, and amount of congestion) as well as the dollar value of time spent travelling. As the dollar value of a time unit spent traveling increases, there is a greater chance that the computer will assign a more expensive but quicker mode of transportation to work (i.e., via automobile or rapid rail rather than bus). The following example will demonstrate how the computer considers the dollar value of time:

```
************************************************
                         TWOCITY
DOLLAR VALUE OF TIME
************************************************

                         SOCIO-ECONOMIC CLASS

           TEAM        HIGH     MIDDLE       LOW

            AA           20         30        10
            BB           30          8         6
            CC           30         30        38
            DD           54         41        30
            EE           52         49        34
```

Assume that the transportation costs for one worker is $150 per year to get to work by bus and $320 to get to work by auto. It also requires an extra 4 time units to travel by bus instead of auto. If the dollar value of time for the population unit were set at $40, then $160 (4 x $40) would be added to the bus cost to arrive at a total cost of $310 to get to work by bus. To take an auto it costs $320 (no extra time units consumed). Therefore, the computer would assign the population unit the bus mode to travel to work. In the same case, if the value of time were set to $50, the total bus cost would $150 plus 4 time units times $50 (dollar value) or $350. Auto would cost only $320. Therefore, the computer would assign these population units the auto mode.

A worker pays only the actual dollar cost to get to work. The dollar value of time is used for route and mode allocation purposes only.

Social decision-maker detailed output

This output shows the characteristics and financial status of the PI's controlled by a social decision-maker in each jurisdiction, in each class, on each parcel. The characteristics and financial status of the PI's in the same class on the same parcel are averages. They can differ only in their employment locations and salaries earned. For all other purposes, the model uses averages for the whole group. The output contains one column for each parcel:

Location and number of PI's: The first two rows identify the residence location and number of PI's in the class living there.

Education level: A PI's educational level affects its chances of obtaining jobs. The higher its educational level relative to educational levels of others seeking employment, the greater its chances of getting a higher paying job. A social decision-maker can increase his PI's educational levels by allocating time to adult education. Public (free) adult education can be provided only by a jurisdiction's School Department. If the School Department does not provide an adult education program, the PI cannot obtain free adult education. If the department does not provide enough adult education for the requests of the people in the jurisdiction, then all of the PI's have only a portion of their requests satisfied. PI's can also allocate time to private adult education, which they are assured of obtaining (if they have enough time units remaining after other time allocations), but which is relatively expensive.

Voter registration per PI: Voter registration represents the maximum number of votes per PI which the decision-maker can cast in an election. If voting is one through the computer, a portion of the registered voters turn out for an election. The decision-maker can increase the fixed minimum number of voters in a PI by allocating time to political activity. The increase lasts for one round only, so a high registration can be maintained only if time is allocated to politics in each round.

Previous savings per PI: This is the savings or deficit which a PI has from previous years.

Percent of PI's unemployed: This is the number of PI's who were unable to obtain full-time jobs, expressed as a percent of the number of PI's of the class living on the parcel.

Average income per PI: The population living on a parcel can derive income from up to four sources: full-time employment, part-time employment, welfare, and miscellaneous (cash transfers from other social or economic decision-makers or government departments). Welfare can be received only by those PI's who are unemployed, and is paid by the jurisdiction in which they reside (if that jurisdiction has a welfare program).

Average expenditures per PI: Most personal expenditures are only partially affected, if at all, by social decision-makers. A level of each residence type has a fixed number of space units. A PI of each class occupies a fixed number of space units. The rent charged at a residence is set by its economic sector owner, and is a factor in the allocation of people to housing in the migration process. *Transportation* expenditures are incurred in the trip to work and to obtain goods and services. Auto, bus and rail may be used in the trip to work, but only auto may be used in commercial trips. All transportation routes and costs are calculated by the computer program. See the *Employment Detail* (page **55**) and *Commercial Detail* (page **62**) descriptions for more information on transportation costs. PI expenditures for *goods and services* are, in part, determined by the amount of time which a PI spends in recreation.

Students are assigned to *schools* by the computer. Middle and high-income families have certain criteria for the school in their district. If the school fails to meet these criteria, these students will be assigned by the computer to private schools at the expense of the population unit they represent. Those criteria are shown on the Master Tables (page **93**). A PI pays for adult education if it has allocated time to private education. There is a fixed cost-per-time-unit spent in private adult education.

A PI has a fixed annual *health* expenditure which varies with the PI's class. In addition to that base amount, a PI on a parcel having surface water or adjoining a parcel having surface water incurs a greater expenditure if there are any coliform bacteria in the water. See the Master Tables (page **94**) for the precise costs.

There are three types of *taxes* which a PI may have to pay: sales taxes, income taxes, and automobile taxes. There is a fixed state *sales tax* rate on all purchases of personal goods and services, regardless of whether the goods or services are purchased from local establishments or from the Outside. Local governments may also set tax rates on PG and PS purchases from commercial establishments within their own jurisdictions. That tax revenue accrues to the government of the seller's jursidiction.

There are fixed federal-state *income tax* rates on all PI's total full-time and part-time gross income. Local governments may also tax the gross income of the PI's living in their jurisdictions and/or working in their jurisdictions. The tax revenue goes to the account of the jurisdiction levying the tax.

There are no fixed *automobile taxes*. Local governments may tax total automobile expenditures to get to full-time and part-time work by PI's living in their jurisdictions and/or working in their jurisdictions.

Miscellaneous expenditures are cash transfers made by the social decision-maker to other social or economic decision-makers or government departments. If miscellaneous expenditures exceeded miscellaneous income, the difference shows up here as miscellaneous expenditures. If miscellaneous income exceeds miscellaneous expenditures, the difference shows up as miscellaneous income.

```
*****************************************************************
              TWICITY
SOCIAL DECISION MAKER 30      HIGH  SOCIO-ECONOMIC CLASS
*****************************************************************

LOCATION                               9223      3833      4030
NUMBER OF PI'S                            1        10        20
EDUCATION LEVEL                          33        30        41
VOTER REGISTRATION PER PI               215       216       216
PREVIOUS SAVINGS PER PI              222574    329010    167533
PERCENT OF PI'S UNEMPLOYED                0         0         0

INCOME PER PI
     EMPLOYMENT(FULL)               1212000   1320000   1200000
     EMPLOYMENT(PART)                131500    134995         0
     WELFARE                              0         0         0
     MISCELLANEOUS                        0         0         0

EXPENDITURES PER PI
     RENT                            250000    322000    275000
     TRANSPORTATION
        AUTO                              0     50400      3333
        BUS                               0         0         0
        RAIL                              0         0         0
     GOODS                           435000    435000    435000
     SERVICES                        173003    167033    217750
     SCHOOL (CHILDREN)                39000     39000     39000
     SCHOOL (ADULTS)                      0         0         0
     HEALTH                            4000     12150     12540
     SALES TAX                        20433     20330     20142
     INCOME TAX                      173433    135025    133000
     AUTOMOBILE TAXES                     0      1000       100
     MISCELLANEOUS                        0         0         0

SAVINGS PER PI                       220512    232476     14442
NEW BALANCE PER PI                   442741    561485    207500


TIME ALLOCATION PER PI

     TRANSPORTATION                       3         5         3
     ILLNESS                              0         1         2
     EXTRA JOB (20)                  (40) 10       10         0
     EDUCATION
        PUBLIC (30)                       0         0         0
        PRIVATE (30)                      0         0         0
     POLITICS (35)                   (25) 25       35        35
     RECREATION (10)                     10        10        10
     INVOLUNTARY                         52        39        50

HEALTH INDEX                              0         7        12
PERSONAL INDEX                          142       112       170
[illegible] INDEX                       142       113       121
ENVIRONMENTAL INDEX                     142       135       204
QUALITY OF LIFE INDEX                     0       110       374
```

Time allocation

As mentioned above, social decision-makers allocate time for their PI's to spend in extra work, adult education, politics and recreation. There are 100 units of leisure time available to each PI. Two types of time allocation are not set by a decision-maker: time in illness and time in transportation. The time units spent in those two categories are first deducted by the computer from a PI's 100 available time units before any time is spent in other activities.

Transportation time is explained above. The number of time units which a PI spends in illness is equal to one-tenth of the health index on its residence parcel. The health index is a function of the use index of the municipal services unit serving the parcel, the amount of overcrowding at the residence, and the amount of coliform bacteria in the surface water on the parcel or on adjoining parcel.

The computer program performs all of the actual time allocation process in response to decision-makers' time allocation requests. If, after time has been subtracted for illness and transportation, the PI has any remaining time units, it may enter the part-time employment process. The amount of time spent in part-time work is subtracted from the remaining time units, and if any time units remain, the PI may enter the adult education allocation process. Politics and recreation are processed last, in that order, not exceeding the 100 allocatable time units.

All of the time which a PI allocated to a specific activity but was unable to spend in that activity contributes to involuntary time. If, during the time allocation process, a PI uses up all of its 100 time units no time may be spent in subsequent activities. There are two main sources of involuntary time. If a PI cannot obtain all of the part-time work which it requests (due to there being a greater number of time units allocated to part-time work than there are part-time jobs) the portion of the allocated time which was unfilled adds to involuntary time. The other source of involuntary time is usually the portion of a public adult education request which cannot be met by local adult education programs.

Involuntary time and transportation time contribute to a PI's [illegible]. Recreation time decreases the personal index.

A social decision-maker sets the dollar value of a time unit travelling for all of a class which he controls board-wide. The dollar value of time of all the high-income people controlled by Team AA on the board, for example, is the same. Social decision-makers can, however, allocate time by jurisdiction and even by parcel. A decision-maker's preferred time allocations appear in parentheses to the right of the row headings labelling the types of allocations. Any exceptions for the decision-maker's preference on individual parcels show the preferred allocations in parentheses next to the actual allocations for the specific parcel. The Social Detailed Output also lists the values of time [illegible] used in the migration process. See the description of Migration (page 42) for details.

Social decision-maker boycott status output

```
***************************************************************
TWO CITY
SOCIAL DECISION MAKER GG       BOYCOTT STATUS OUTPUT   ROUND 2
***************************************************************

         BOYCOTTING                                 BOYCOTTED
TEAM   CLASS OR  FUNCTION                 LOCATION  LAND USE   OWNER
       LAND USE

 GG      HIGH      WORK                                         SC1
```

Social decision-makers can boycott specific employers, specific PG or PS establishments, or either the bus or rail modes of transportation. A boycott is in effect for an entire round and is continued until a decision is submitted to stop the boycott. The boycott output has one row per boycott, showing the social decision-maker boycotting, the class boycotting, the function boycotted (work, shop, or use), the location boycotted (0 if the boycott is against working for a government department), the land use boycotted (0 if the boycott is against a government department), and the owner of the establishment being boycotted (department and jurisdiction if the boycott is against a government department).

Summary information for the social sector

Social control summary totals

This table shows, by class and jurisdiction, the number of population units controlled by each social decision-maker. A social decision-maker begins a game controlling a certain number of PI's in each class in each jurisdiction (that number may be zero.) The number of PI's which the decision-maker controls in subsequent rounds in determined by the migration process, which moves PI's into, out of, and within the simulated region in response to both local and exogenous influences. The migration process allocates people to housing; it does not determine which social decision-makers control those people. Before the start of a game, each parcel in the simulated region is assigned a decision-maker for each of the three social classes. When a class occupies a parcel, it comes under the control of the decision-maker originally assigned to that class on that parcel.

```
*******************************************************
        TWOCITY
  SOCIAL CONTROL SUMMARY
*******************************************************

           JURISDICTION 1        JURISDICTION 2

 TEAM       PH    PM    PL        PH    PM    PL

  AA         0   106     0         0     0     0
  BB        46     0     0         0     0     0
  CC         0    22     0        26     0     0
  DD         0     0     0         0     0   147
  EE        45     0     0        13     0     0
  FF         0     0     0         0    61     0
  GG        33     0     0        43     0     0
```

Social control summary (one table for each social decision-maker)

This table contains one row for each class on each parcel controlled by the social decision-maker. The first two columns show the residence parcel coordinates and the class. Next is the average income for a household (family) of that class living on that parcel. A household consists of one full-time worker. The number of workers in a PI of each class and the typical full-time salary earned by a worker in the class are shown on the Master Tables (page 92). In almost all of the model's processes, all PI's in the same class living on the same parcel are treated alike, so the average for a parcel is, in effect, the actual for a PI.

```
**********************************************************************
          TWOCITY
     SOCIAL CONTROL SUMMARY TEAM AA
**********************************************************************
                        FAMILY INCOME                          TOTAL
 LOCATION    CLASS      (PER WORKER)    AMILY SAVINGS    DISSATISFACTION

   8628      MIDDLE         5500             -351              259
   9028      MIDDLE         2500            -1678              285
   8830      MIDDLE         6187             1053              262
   9030      MIDDLE         5153              640              238
   8832      MIDDLE         6125             1061              235
   9032      MIDDLE         5849             1334              255
   9232      MIDDLE         5500              321              240
   9034      MIDDLE         5850              325              240
   9234      MIDDLE         3680            -1866              267
```

The fourth column contains the average savings per family for the year. The figure is annual income less annual expenditures, and does not include any savings or dissavings from previous years.

The final column, total dissatisfaction, is the total of all of the indexes measuring the effect of local conditions on the population of the parcel. The higher the dissatisfaction, the worse the conditions. The dissatisfaction index is the quality of life index, which is a factor in the migration process. The dissatisfaction index printed here is calculated before the migration process and reflects conditions existing in the last round.

Social control summary (two graphs for each social decision-maker)

The two graphs printed for each social decision-maker show an historical comparison of two types of information shown on the previously-described table: net income and quality of life index. On the tables, information is given for each class on each parcel which the decision-maker controls. The information on the graphs, on the other hand, is the average of all the PI's in the same class controlled by the decision-maker. The graphs show the relative values of those items for the most recent ten years. Each year has three columns on the graph, one for low-income (L), one for middle-income (M), and one for high-income (H). Four years of data are loaded with the model. Round 2 is year 5 on the graph, round 3 is year 6, and so on. After 6 rounds have been played (years 5 through 10 on the graph), the data for the earliest year are erased and only data for the most current 10 years are shown. Year 10 is always the most recent round.

```
TWCCITY
SOCIAL CONTROL SUMMARY TEAM GG

- NET INCOME -
```

On the net income graph, the net income for each class for each year is shown as a ratio to that class's net income during the first year. The first year is always 1.00. Thus, although high-income PI's usually have a higher net income than middle-income PI's, their incomes relative to previous years can be easily compared even across classes.

Note: If a decision-maker does not control any PI's in a particular class during a year, that class's letter prints on the bottom row of the graph.

```
*************************************
  ROUND  2
*************************************
- QUALITY OF LIFE INDEX -
500
450
400
350
300
250
225
220
215
210
205
200
195
190
185
180
175
170
165
160
155
150                       MH    H
145
140
135
130
125
120       L
115
110                            M
105  L              L
100            L     M
 95   M               H
 90             M
 85
 80    H   M     H
 75         H
 70
 65
 60
 55
 50
 45
 40
 35
 30
 25
 20
 15
 10
  5
  0                      L    L
      1    2    3    4    5    6    7    8    9   10
```

The quality of life index graph shows each class's average quality of life index as an absolute value, not relative to a base year. Each class measures the factors in the quality of life index differently, so there can be little comparison between classes on this graph. The main comparison is within a class between years.

Social sector decisions

Summary of decisions

The three socio-economic classes all have the ability to make the same types of decisions in the model, although the relative effect of these might be different. Further, most of the power in this sector will be manifest only if teams are able to join with one another in some form of organization. For example, a strike by the population units under Team AA's control may not be effective at all if the other teams allow their population units to work for the employer. In fact, if the latter happens likely the only one disadvantaged would be the population units of Team AA. The same general principle applies to voting and the development of political power.

There are four basic types of decisions available to this sector: voting, boycotting, allocating (or budgeting) time, and transferring cash.

Voting: People exercise power over those who govern them by periodic elections, by expressing their opinions via polls, and by voting in referenda to determine the acceptability of certain expenditures.

The Social Decision-Maker is able to exercise all of these options. The Chairman and the Council are elected officials. It is possible to vote each round, or at regular intervals even in off-election years, to indicate agreement or disagreement with current government policies and to vote on specific referenda. The number of votes which can be cast is determined in part by the number of registered voters controlled by each decision-maker.

Voting is an important instrument. Politicians, if they expect to be elected, must have the support of a number of social decision-makers representing at least a popular majority. Support can be gained in a number of ways. Candidates can be bound to certain principles and programs or campaign promises can be made. The voting system represents the political process in the model with coalitions, factions, and political tradeoffs as found in the real world.

Boycotting: A powerful negative sanction available to the social decision-maker is the ability to withhold the labor or purchasing power of the people he controls. In addition to the work or transit strike, it is possible to stop shopping at particular establishments. The computer assigns people to shop at particular goods and services establishments and to work at specific jobs; decisions to boycott particular establishments cause the computer program to ignore those places as options for the boycotting population units. It will continue to do so until told to stop by a decision input to stop the boycott.

The computer usually attempts to make its assignments in a fashion that will provide to the population units the greatest economic benefit. If a boycott is established it is possible for the people to lose money or pay increased costs to the extent that the computer may have to search for a less attractive second choice to assign people to work or shop.

Allocation of time: Whereas the voting procedure gives the social sector some control over the operations of the government sector, and the ability to boycott gives a degree of influence in the economic sector, the allocation of time is a decision that has many interactive effects. The time which is allocatable is a worker's leisure time -- that time not spent in full-time work, eating, sleeping, or personal care. Leisure time is divided into 100 units which can be allocated to part-time work, adult education, political activity, or recreation.

However, allocatable time is decreased by the amount of time which it takes workers to travel to and from their place of employment. Therefore, the actual amount of time which can be allocated by you is 100 units minus time spent traveling to and from work. The number of time units consumed in traveling to and from work varies according to road types, transportation modes, congestion, and distance traveled.

Allocatable time is further decreased if a population unit lives on a parcel having a high health index and the subsequent high rate of illness. A parcel's health index is a function of its pollution index, residential overcrowding, and the use index of the municipal service plant serving the parcel.

The following are the various possibilities for time allocation:

Extra work: the ability to augment income derives from working longer hours or at more than one job. There are only select areas which offer part-time employment opportunities; the School Department in the Government Sector and a few in the Economic Sector. Workers are paid in proportion to the amount of time they are able to work and in direct proportion to their salary. If there is no part-time position available, the unfilled requested time becomes involuntary leisure and adds to personal dissatisfaction.

Education: It is assumed that unless a certain amount of time is spent in keeping up skills and learning new techniques and information, the education-skill level of the population units declines relative to other population units. It is the level of this skill that largely determines the ability of population units to get better jobs -- in fact, it may determine the ability to get any job. To provide for formal training, there is adult education. This education can be provided both on the public and private sector. The public education is free (the private, of course, is not). If there is no adult education or not enough made available by the School Department, the time allocated to this use will be assigned to involuntary leisure time and add to personal dissatisfaction.

Politics: The number of voters turning out for the election of a particular candidate, a poll, or a referenda, is normally determined as a random percentage of a population unit (varied by socio-economic class). This percentage can be positively influenced by the expenditure of greater amounts of time in political action. Only that class of the population units which assignes the time to politics gains increased voter turnout.

Recreation: The amount of leisure time available positively affects the dissatisfaction of the population units. However, a decision to spend time in this fashion requires the expenditure not only of time units but also the purchase of goods and services from PG and PS establishments. Remember that time allocation is a debit-credit concept. Population units start with 100 units of time for each class in each jurisdiction. Teams may estimate that 15 units of time are going to be consumed between traveling to and from work and in sickness for their units. The PI's then only have 85 units of time left. For example, in studying the computer output for PL (low-income population) units, teams may discover that the PL's are not receiving enough income, so the team will allocate 40 units to extra employment. Further, because the education-skill level of those units also happens to be low, the team might allocate 25 units for public adult education. The PL's now have only 20 units left for politics and recreation.

After the computer run and the generation of a new round of output, the team may discover that it estimated incorrectly when calculating the time consumed in traveling to and from work and sickness. Because of increased congestion on the highways it took 30 units of time rather than 15. This means that the team allocated 15 units too few to travel and the computer program will subtract the difference from the less important time allocations of recreation and politics.

Note on time allocation decisions: It is important that jurisdiction-wide time allocation decisions precede parcel-specific time allocation decisions on the input forms submitted for computer processing. If a parcel-specified time allocation decision is followed by a jurisdiction-wide time allocation decision for the jurisdiction that contains the specified parcel, the jurisdiction-wide decision will override the previously input parcel-specific decision.

Cash transfer: The only direct allocation of money allowed the social sector is the ability to transfer savings to any other social, economic, or government account. Such a transfer enters the receiver's general cash reserves. The transfer might be for the purpose of aiding a pollution abatement program, or a business forced by the government to close because of its pollution might be required to [illegible] money to its unemployed workers. However it is used, the ability to transfer cash allows the social sector many possibilities for affecting other parts of the system.

Set the dollar value of a time unit travelling to work: The computer assigns all population units to modes of transportation to and from work on the basis of least cost. Least cost includes transportation charges per mile (which differ according to mode of transportation, type of road and amount of congestion) as well as the dollar value of time spent traveling. The social decision-maker is able to indicate the dollar value of one time unit of consumer traveling to and from work for each of the classes which he represents. As the dollar value of a time unit spent travelling increases, the chances are that the computer will assign a more expensive but quicker mode of transportation to work.

Input format

Local system decision-makers (such as the social sector teams) use a standardized input form (see below) when making decisions that must be processed by the computer.

The standard message format is:

$CODE/ = dm/a, b, c, d, ...

$CODE stands for the type of decision code. The Social Sector has the option to make decisions that use the following decision codes:

[illegible] (boycott workers or shop locations)

[illegible] (allocate time)

[illegible] (transfer cash)

[illegible] (set the dollar value of a time unit travelling to work)

dm is the decision-maker, which for the Social Sector is a double letter code ([illegible], [illegible], etc.).

The columns a, b, and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required, omitting commas within numbers (100000).

RIVER BASIN MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	
$ /	= /	,	,	,	,	,	,	,	,	,	,	

Social decision-makers: Input Explanation Form

Type of Decision	Code	Decision Maker	a	b	c	d	e	f	g
Allocate time by jurisdiction, by class	STIME	AA, BB, CC, etc.	class (H, M, or L) and jurisdiction (1, 2, or 3)	time units in extra work; if none, 0	time units in public adult education; if none, 0	time units in private adult education; if none, 0	time units in politics; if none, 0	time units in recreation; if none, 0	
Allocate time by jurisdiction, by class, by parcel	STIME	AA, BB, CC, etc.	class (H, M, or L) and jurisdiction (1, 2, or 3)	time units in extra work; if none, 0	time units in public adult education; if none, 0	time units in adult education; if none, 0	time units in politics; if none, 0	time units in recreation; if none, 0	residence location
Boycott	SBYCT	AA, BB, CC, etc.	S	class boycotting (H, M, or L)	function boycotted (Shop or Work)	location boycotted (0 if department)	Stop the boycott or Begin it	if applicable, department (SC, MS) and jurisdiction (1, 2, or 3)	
Transfer cash	SCASH	AA, BB, CC, etc.	C	Receiver (economic or social decision-maker or department and jurisdiction	amount (in dollars)	class giving	if social decision-maker receiving, class receiving (H, M, or L); if economic decision-maker receiving, PVT; if department receiving, CAPital or CURrent account	residence location of giver	if social decision-maker receiving, residence location of receiver; 0 for all else
Set the dollar value of a time unit spent travelling to work	SVALUE	AA, BB, CC, etc.	class (H, M, or L)	dollar value of time unit travelling					

Social sector sample decisions

All social sector decisions are made by teams for a single class at a time. The social teams can make systemwide decisions (boycott and set the value of time), and jurisdictionwide decisions (vote and allocate time), and two types parcel-specific decisions (cash transfer and allocate time).

Boycott:

The PM's controlled by social team AA are beginning a work boycott of the employer located on parcel 9630.

Decision Code	Decision-Maker	a	b	c	d	e	f
$ BYCT /	= AA /	S ,	M ,	W ,	9630,	B ,	

The PL's controlled by team FF are stopping their shopping boycott of the commercial establishment on parcel 10030.

$ BYCT / = FF / S , L , S , 10030, S , ____

The PH's controlled by team CC are beginning a work boycott of the School Department in Jurisdiction 3.

$ BYCT / = CC / S , H , W , 0 , B , SC3

Time allocation (jurisdiction-wide):

Social team AA has all of its PM's in Jurisdiction 1 allocate 20 time units to an extra job, 30 to public adult education, none to private adult education, 25 to politics, and 10 to recreation. Note that the jurisdiction number must always be given.

$ TIME / = AA / M1 , 20 , 30 , 0 , 25 , 10

Time allocation (parcel-specific):

Social team AA wishes to make the time allocation for its PM's on parcel 9436 (in Jurisdiction 1) different from that of all its other PM's in Jurisdiction 1. These specific PM's are to have an allocation of 0 for an extra job, 0 for both forms of education, 55 for politics, and 35 for recreation.

$ TIME / = AA / M1 , 0 , 0 , 0 , 55 , 35 , 9436

Cash transfer:

Social team AA makes a deal with social team FF whereby it transfers $15,000 from its PH's on parcel 9432 to the PL's of team FF on parcel 10032.

Decision Code **Decision-Maker** a b c d e f g

$ CASN / = AA / C , FF , 15000 , H , L , 9432 , 10032

Social team BB gives $6500 to the School Department current account in Jurisdiction 3 from the account of its PM's on parcel 9836.

$ CASH / = BB / C , SC3 , 6500 , M , CUR , 9836

Set the dollar value of time:

Social team CC sets the dollar value of a time unit spent travelling to work at $20 for its low-income people.

$ VALUE / = CC / L , 20 , ____ , ____ , ____ , ____

The vote procedure

Players submit input forms with votes for candidates for public office, opinion polls, and measures of governmental performance. Each of these categories fall under the *VOTE* option. However, none of the player inputs are in the form acceptable to the computer program. Consequently, the game director must recode the vote inputs based on the information from all player vote inputs.

Players (social decision-makers) submit their inputs for each election or poll and identify the category and purpose of each vote on the right-hand side of their input form. For each election or poll the game director must assemble each decision-maker's votes and then order and punch the voting inputs.

Input explanation form: There are three types of *VOTE* available to social decision-makers. The first involves the election of candidates for public office. The slate of candidates may represent either the whole bureaucracy (as headed by candidates for chairman) of each jurisdiction or particular departments in the government sector ([illegible], [illegible], [illegible], etc.) of each jurisdiction. This *VOTE* option may also be employed in off-year elections to run polls comparing the incumbent(s) with the potential challenger(s).

A measure of government performance is made possible by the second option of *VOTE*. Here social decision-makers evaluate the performance of particular departments and/or the chairman for each jurisdiction.

Option three enables a response to questions applicable to a whole jurisdiction, board-wide area, or social class within those two areas. Only negative or affirmative responses are permitted.

Social decision-makers: Vote Input Explanation Form

Type of decision	Code	Decision-Maker	a	Note opposite decision
Election vote	SVOTE	*A, B, C, etc., or A1 or A2 etc.	letter of candidate	(election in jurisdiction 1 or 2 or 3 for department MS, SC, etc. or whole slate)
Government performance measure	SVOTE	*A, B, C, etc.; or A1 or A2 etc.	P = excellent Q = above average R = adequate S = poor T = unacceptable	(jurisdiction 1 or 2 or 3; department MS, SC, etc. or whole bureaucracy)
Opinion polls	SVOTE	*A, B, C, etc.; or A1 or A2 etc.	Yes or No	(issue # by jurisdiction 1 or 2 or 3)

*Single letters only (not AA, BB, etc.); 1, 2, and 3 refer to low, middle, and high income population units respectively. The absence of a number indicates that the vote applies for all classes controlled by that particular decision-maker.

Social sector strategies

Gaining a perspective of the model

In a sense, the range of formal social sector decisions is limited as compared to the economic or government sectors. In addition, actions like strikes, boycotts and elections are not everyday things. Also, while the time allocation process is a powerful instrument, it may not have the same sustaining challenge as major economic or government decisions.

The real power, then, of the social sector can be developed through its influence on the goals, priorities, objectives, plans and actions of the other sectors. To exert this influence the social sector participants should acquire an understanding of the whole city and become involved in the very early rounds with the flow of action in all sectors.

Some of the ways in which this can be accomplished are listed below:

Use of maps: The social sector should make the maximum use of a variety of maps. For instance, a sequence of maps portraying a real city can be used to show such things as landforms, demographic data, geography, transportation patterns, social characteristic distribution and planning forms.

These maps can provide the graphic orientation to the abstraction of the model's computer maps. The social sector should gain a familiarity with the model's 26 maps which are printed each round. These graphic portrayals depict the kind of comprehensive descriptions from which participants can acquire a "feel" for the physical characteristics of the region. This awareness can become the framework within which plans, priorities and objectives can be structured.

Equipped with this perspective of the whole region, the social sector should, from the very beginning, set out to develop their own positions on plans, priorities and objectives for the region. Even though this sector may not have direct decision power on such things, for instance, as spending of money, patterns of development and zoning they are all major activities which affect people -- and as such are of direct interest to the social sector.

Some examples of things which may be of specific interest to the social sector -- even though activating decisions are made in other sectors -- are: housing development for mixed-income groups; full-time and part-time jobs; improved bus routes; increased parklands; more available adult education; improved local water quality.

Establishing a joint effort

As in real life, the people (social sector) are frequently neglected until an election or massive boycott takes place. To counter this neglect, the social sector can, and should, develop some forms of liaison or consortium of interest. While there can be many forms of joint venture it should not be assumed that these are easy to establish. The record of community action groups reflects the difficulties of establishing common interests, developing effective leadership, gaining agreement on goals and creating sustained organizational strength. It may be that ad hoc relationships have the best chance of survival and success.

A prerequisite of all group ventures is the discussion, examination and hammering out of some form of goals, priorities and plans. Some of the possible social sector alliances which have proved to be effective are listed below with some comments on their purposes.

Income group caucus: It may be useful, for some limited purposes, for members of high, middle or low income groups to join together to establish positions or strategies in their own exclusive interests.

Geographic alliances: In both stable and dynamic situations there are many conditions (such as poor transportation services, industrial impacts, school conditions, environmental deficiencies) which suggest the need for a "community" alliance of all residents. To be effective in influencing change in one section, it is likely that tradeoffs relating to the whole region will be involved and sectional, or geographical groups, should be prepared to respond to these.

Social sector bloc: While the social sector is construed as one component of the model, the interests of the various income groups are different and competitive. Interclass hostility is not unusual. It is possible, however, with articulate leadership and some common causes, for the whole social sector to establish a people's bloc devoted to common goals or objectives such as housing, education or minimum salaries. In this case, social sector participants must be prepared to make short-term concessions and sacrifices in the interest of long-term gains for the whole social sector (the people). For example, a social sector bloc could bring pressures on the government to establish a Housing Coordinator with responsibility and power to intercede in Economic Sector residential decisions. A social sector bloc could also arrange with a favored, or responsive, businessman (Economic Sector) for a consortium effort in the development of residences. The social sector could make funds available to this business venture through cash transfers.

The art and science of negotiation

Among the rewarding aspects of participating in the social sector are the knowledge and skills acquired in the techniques of advocacy and negotiation Whether operating independently, or as a group, it is essential that social sector participants know their own situation well and have effective information about their "adversaries." In the early rounds there is either a reluctance to negotiate from limited strength or a tendency among social sector participants to assume that their needs and interests will be easily recognizable and accepted by economic and government decision-makers.

The social sector decision-maker should initially assume that the interests of other sectors, and other decision-makers, will not coincide with his own and may well be contrary. While the social sector may be interested in lower rents and higher salaries, the controlling businessman may be interested in maximizing profits through higher rents and lower salaries. A more subtle difference can occur in the area of quality housing. A businessman may conclude that his best move is to demolish low income housing which the social sector would like to have upgraded or restored.

Social consciousness should be assumed to be a sometimes strategy for businessmen and most governments. (It occasionally happens, in a gaming situation, that altruism comes easier than reality dictates.) The social sector, then, should be prepared to face hard-nosed bargaining, deception, indifference and failure. Anticipating these conditions, it is important that as much information as possible be assembled -- within the time available -- so that requests and demands be accompanied by tradeoff positions; agreements be sealed in writing on decision forms; extra support and pressures be lined up for additional bargaining power if needed; and so that the "threat" of economic or political pressure be made apparent at strategic times. If negotiations fail, more work should be done in strengthening the presentation.

For example, if the social sector chooses to accuse a mayor (or government) of failing to move a city forward in the areas of income or the quality of housing or efficient public transit, it should be prepared to address such things as: dissatisfaction trends, growth rates, salary indices and trends, relative costs of auto and bus transportation, changing housing quality indices, new construction, patterns of development or growth, business conditions and taxes and assessment policies and rates.

Having done this research and analysis from available information, the social sector could assume that a mayor would be both defensive and interested in staying in office. By being tough on the issues (based on homework analyses) and avoiding diversionary rhetoric, the social sector can force the heat to be directed toward the mayor and his interest in staying in office. In dealing with the economic sector, the social decision-makers should acquire as much business intelligence as possible pertaining to profits, favorable tax rates, assessment patterns, subsidies, wage and price trends. They can use the leverage of their political power to influence the economic sector.

All of these actions are beyond the formal decision process but within the implied nature of the social sector and consistent with the individual interests, talents and experiences of social decision-makers.

Decisions: general to specific

An interesting aspect of the social sector is the spectrum of responsibility each decision-maker has in representing population units (people). This spectrum can range from a specific location (9032) with one population unit (500 people) to a whole population class (PH, PM, PL) of thousands of people living in many square miles of the region. The social sector participant has the opportunity to represent the interests of, for example, people in small communities who may be in debt, unemployed, underemployed, affluent, urban, suburban, rural, satisfied or dissatisfied.

In the early stages, the social sector decision-maker will probably concentrate on decisions affecting whole classes of people (High PH, Middle PM, or Low PL). The concerns will be primarily with financial status, satisfaction trends, education and employment characteristics. While the research to make decisions will be related to specific locations, the analysis, at this stage, should probably involve whole classes, or all the people the decision-maker represents.

In the process, it is useful for each decision-maker to identify (color code), on an economic status map, the locations at which his people live, work and shop and the routes travelled to work and shops.

Following these general approaches, the social decision-maker will be doing the following things in the early rounds:

Identifying and establishing a sense of the physical community in which he is involved.

Building a set of personalized objectives, goals and priorities for the community.

Establishing a list of objectives and priorities for the class(es) of people he represents.

Establishing a set of objectives and priorities for individual locations of people.

When the decision-maker has the feel for the extensive interactions which are influencing his status, he can very readily concentrate on the research and analysis in employment, transportation, housing, education relationships, income and expense relationships which are basic to improving the condition of population units at individual locations. In addition, working from general to specific understandings can enable the social decision-maker to establish the most effective liaisons and alliances with other participants.

Labor Unions are a good example. It will not take very long for social decision-makers to identify, or isolate, those employers (economic sector) who seem to be operating in an indifferent manner toward employees. At this point discussions and liaisons, across income class lines, can easily lead to a pattern of union organization designed to serve the best interests of employees.

The exercise of power

There is no doubt that acquiring, exercising and maintaining power -- political and economic -- is an appealing aspect of gaming, as it is in the real world.

An interesting aspect of this model is the power relationships. The government and economic sectors both start with a considerable degree of open power. The social sector, on the other hand, has latent power, which must be actively pursued to be effective.

The Social Sector has the decision option to boycott shops or work (strike). This is frequently an effective method to achieve desired changes in prices or wages. An equally effective exercise of power can be the threat of boycott or strike.

While a shopping boycott hurts a businessman, it also requires the consumer (social sector) to purchase required goods and services elsewhere at higher costs; while a work boycott (strike) hurts a businessman's production and income, it may also cause the striker (social sector) to be without income for a year. For the artful gamesman, therefore, the exercise of power may be conducted through the threat of boycott. The threat, delivered to the economic sector with confidence, courage and skill may achieve the objectives without cost to the social sector. Timing is important as is the degree of support which the Social Sector decision-maker can count on in his behalf.

A businessman (Economic Sector) who is in the process of upgrading, expanding or developing his business activities at considerable expense is very vulnerable to the threat of a boycott or strike which will decimate his income for a year. A threat may include very extensive from social decision-makers who may be reluctant to actually boycott.

In the exercise of political power a whole range of options are available to the Social Sector, from the single request to the government sector for assistance to the ultimate power play of "taking over" the government through the electoral process.

The threat of action need not be political extortion, rather it can be a forceful persuasion concerning the source and the sharing of the exercise of political power.

```
                  POPULATION UNIT MASTER TABLE

                              PH          PM          PL
                              --          --          --

GENERAL CHARACTERISTICS
-----------------------

  POPULATION                 500         500         500
  WORKERS                    120         160         200
  STUDENTS                   130         140         100
  EDUCATION RANGE          70-99       40-69        0-39
  REGISTERED VOTERS          200         140         100

MOBILITY CHARACTERISTICS
------------------------
  SELECTION OF MOVERS

    RANDOM MOVERS             7%          5%          1%
    MOST DISSATISFIED      ( HALF OF THE 20% WITH HIGHEST
                            QUALITY OF LIFE INDEX)
    PERCENT OF UNEMPLOYED 35          25          15
    PERCENT OF UNDER-      35          25          NA
     EMPLOYED
  SELECTION OF HOUSING
  CRITERIA
    HOUSING QI RANGE       71-100      40-100      20-70
     CONSIDERED
    MAXIMUM OCCUPANCY      120%        120%        120%
     CONSIDERED
    ENVIRONMENT INDEX  (LOWEST INDEX VALUE IS MOST PRE-
                        FERRED)
  CHARACTERISTICS OF
   IN-MIGRANTS FROM OUTSIDE
    EDUCATION LEVEL        85          55          15
    VOTER REGISTRATION    200         140         100
    PREVIOUS SAVING         0           0           0
    TIME ALLOCATION
      EXTRA JOB            20          30          40
      PUBLIC ADULT          0          20          20
       EDUCATION
      PRIVATE ADULT        20           5           0
       EDUCATION
      POLITICS             40          20          10
      RECREATION           10          10          20

INCOME CHARACTERISTICS
-----------------------
  WORKERS PER PL           120         160         200
  FULL EMPLOYMENT SALARY (SALARY PER WORKER TIMES NUMBER OF
                          WORKERS
  PART-TIME SALARY       (80 TIME UNITS PROVIDES FULL-TIME
                          SALARY)
  WELFARE                (LOCAL JURISDICTION PAYMENTS PER
                          WORKER TIMES THE NUMBER OF
                          UNEMPLOYED WORKERS
  MISCELLANEOUS           CASH TRANSFERS FROM OTHER ACCOUNTS
```

```
                        POPULATION UNIT MASTER TABLE
                        ----------------------------
                                 PH          PM          PL
                                 --          --          --
EXPENDITURE CHARACTERISTICS
---------------------------
  RENT

    SPACE UNITS CONSUMED  2.00         1.50        1.00
  TRANSPORTATION
    MAXIMUM PERCENT OF SALARY
     WILLING TO BE SPENT TO
     GET THE JOB
    COSTS PER WORKER       15%          20%         25%
     FOR JOB
    AUTO
     BASE AUTO COST      $210         $150        $140
     COST PER HY LINK
      (UNCONGESTED)
        HY3              $100         $ 67        $ 75
        HY2              $125         $112        $100
        HY1              $150         $137        $125
     PUBLIC TRANSIT      (FARE SET BY TRANSIT AUTHORITY)
       MAXIMUM PL'S PER   50           40          30
         PF1
       MAXIMUM PL'S PER   25           20          15
         BUS 1
       UNIT PUBLIC TRANSIT2.0          2.5         3.3
         CONSUMED

  TRAVEL TO PC (AND TO PS):
   BASE COST PER CU            $ 50        $ 50        $ 50
    COST PER CU                $125        $125        $125
    CONSUMED (ALONG HY3)
    (ALONG HY2 IS TWICE AS       (THESE COMMERCIAL TRANS-
     MUCH AND ALONG HY1 IS       PORTATION COST ARE ONLY
     THREE TIMES AS MUCH)        INCURRED IF PURCHASES
                                 ARE MADE FROM LOCAL
                                 SUPPLIERS
NORMAL PC CONSUMPTION          34          28          21
  (CU'S)
  ADDITIONAL CU'S OF           0.100       0.050       0.025
  PC FOR EACH TIME UNIT
  IN RECREATION

NORMAL PS CONSUMPTION (CU'S)  16          11           7
  ADDITIONAL CU'S OF PS FOR   0.075       0.050       0.0
  EACH TIME UNIT IN RECREATION

SCHOOLING OF CHILDREN

  CRITERIA FOR ATTENDING PUBLIC SCHOOL
  MINIMUM SCHOOL VALUE RATIO  80          60          NONE
  MAXIMUM RATIO OF STUDENTS/  16          22          NONE
  TEACHER
  MINIMUM RATIO OF PH         1.0         0.75        NONE
     TEACHER TO PM

     COST OF PRIVATE         $39000      $24500      $12500
   EDUCATION (PER FULL PI)
        COST PER STUDENT     $300        $175        $125
   SCHOOLING OF ADULTS
     COST PER TIME UNIT      $3000       $3000       N/A
     ALLOCATED TO PRIVATE
     ADULT EDUCATION
```

```
                 POPULATION UNIT MASTER TABLE
                 ----------------------------
                                 PH           PM           PL
                                 --           --           --
HEALTH EXPENDITURES (PER PL)
  BASE AMOUNT                  $8000        $4000        $2000
   COLIFORM PARTS/MG
   GREATER THAN 100            $400/PART    $200/PART    $100/PART
   COLIFORM PARTS/MG           $160/PART    $ 80/PART    $ 40/PART
   LESS THAN 100
TAXES
  SALES TAX
   STATE                     (3% OF THE DOLLAR AMOUNT OF PG AND
                              PS PURCHASES)
   LOCAL                     (DEPENDS UPON THE RATES SET BY THE
                              LOCAL JURISDICTION OF PG AND PS
                              SEPARATELY)
   INCOME TAX
   FEDERAL (ON SALARIES)

                                  6%           4%           1%
   LOCAL                     (SET BY THE LOCAL JURISDICTIONS)
  AUTOMOBILE TAXES  (DEPEND UPON RATES LEVIED BY
                    JURISDICTION OF RESIDENCE AND/OR WORK)

MISCELLANEOUS EXPENSES  (CASH TRANSFERS TO OTHER ACCOUNTS IN
                          THE SOCIAL, ECONOMIC, OR GOVERNMENT
                          SECTORS)

TIME ALLOCATION                 100          100          100
(TOTAL TIME UNITS)

AUTO TRANSPORTATION (UNCONGESTED)
  PER LINK HY3                  2.5          2.5          2.5
  PER LINK HY2                  5.0          5.0          5.0
  PER LINK HY1                  7.5          7.5          7.5
BUS TRANSPORATATION
  WAITING                         1            1            1
  ALONG HY3                     5.0          5.0          5.0
  ALONG HY2                     7.5          7.5          7.5
  ALONG HY1                    10.0         10.0         10.0
RAPID RAIL TRANSPORTA-          2.5          2.5          2.5
 TION
  WAITING                         1            1            1

WALKING                         2.5          2.5          2.5
ILLNESS             (HEALTH INDEX FOR THE PARCEL ON WHICH
                       THE PL'S RESIDENCE IS LOCATED DIVIDED
                       BY 10)
EXTRA JOB           (80 UNITS OF PART-TIME WORK IS EQUIVALENT
                       TO A FULL-TIME JOB)


                POPULATION UNIT MASTER TABLE
                ----------------------------
CONGESTED ROADS AT PEAK-HOURS (ALL TO WORK TRIPS) CAUSE
AN INCREASE IN THE DOLLAR AND TIME COSTS OF AUTOMOBILE
USAGE. FOR EXAMPLE, A ROAD THAT IS 25% CONGESTED
(UTILIZED 125%) WILL COST 25% MORE IN BOTH MONEY AND
TIME FOR THOSE WORKERS WHO USE IT.
```

```
                 POPULATION UNIT MASTER TABLE
                 ----------------------------
                            PH          PM          PL
                            --          --          --
EDUCATION

  TIME UNITS REQUIRED TO   32          24          30
  MAINTAIN THE HIGHEST
  LEVEL
  TIME UNITS REQUIRED TO   16(80)      12(50)      12(10)
  MAINTAIN THE EDUCATION   24(90)      18(60)      18(20)
  LEVEL SPECIFIED IN THE   32(99)      24(64)      24(30)
  PARENTHESIS
TYPICAL DECLINE IN EDUCA-   2           2           2
  TIONAL LEVEL IF NO TIME
  IS ALLOCATED FOR ADULT
  SCHOOLING
ALLOCATION TYPICALLY       16          12          18
  NEEDED FOR STAY AT
  PRESENT LEVEL

POLITICS - UNITS OF TIME  (INCREASES IN VOTER REGISTRATIONS
  REQUIRED TO INCREASE     LAST FOR ONLY ONE ROUND)
  VOTER REGISTRATION:
          7%               10          10          10
         10%               50          50          50
         15%               80          80          80

WATER CONSUMPTION (MG)

  DAILY IF LIVING IN:
                        RA  0.080       0.070       0.020
                        RS  0.070       0.050       0.030
                        RC  0.060       0.030       0.020
  ANNUALLY IF LIVING
   IN:
                        RA  29          25          11
                        RS  25          18          11
                        RC  22          11           7




              QUALITY OF LIFE FACTORS FOR POPULATION UNITS
              --------------------------------------------
                            PH          PM          PL
                            --          --          --

HEALTH INDEX
------------

  MAXIMUM VALUE            100         100         100
  POOR MS
                          (MS USES INDEX - 100)/ 4; MAXIMUM=15
  RESIDENCE CROWDING      (% OCCUPANCY - 100)/ .5; MAXIMUM=20
  COLIFORM INDEX           PARTS/MG / 4; MAXIMUM=50
```

```
          QUALITY OF LIFE FACTORS FOR POPULATION UNITS
          --------------------------------------------
                                 PH          PM          PL
                                 --          --          --
   TAX RATES IN
    LOCAL JURISDICTION
      EACH MIL OF RESI-
      DENT INCOME               .250        .250        NONE
      EACH MIL ON GOODS         .250        .250        NONE
      EACH MIL ON SERVICES.250              .250        NONE
      EACH MIL ON LAND          .125        .125        NONE
      EACH MIL DEVELOP-         .125        .125        NONE
       MENTS
    WELFARE PAYMENT
      FOR EACH $100
                                NONE        NONE         4
       BELOW $2000

HEALTH INDEX + TIME INDEX = PERSONAL INDEX
POLLUTION INDEX + NEIGHBORHOOD INDEX = ENVIRONMENT INDEX
PERSONAL INDEX + ENVIRONMENT INDEX = QUALITY OF LIFE INDEX

TIME INDEX
----------

  TRANSPORTATION
    TIME CONSUMED
     AUTO - WAITING              0           0           0
         HY3                    2.5         2.5         2.5
         HY2                    5.0         5.0         5.0
         HY1                    7.5         7.5         7.5
    BUS - WAITING                1           1           1
         HY3                    5.0         5.0         5.0
         HY2                    7.5         7.5         7.5
         HY1                   10.0        10.0        10.0
    RAIL - WAITING, ANY LEVEL,
     WALKING (PER SEGMENT)
                                 1           1           1
    RECREATION           (MAXIMUM = 0 MINIMUM = -100)

    INVOLUNTARY          (100 MINUS TIME SPENT IN ALL ACTIVITIES)

    POLLUTION INDEX       VALUE PRINTED FOR THAT PARCEL OF LAND
    ---------------
                          IN WHICH THE RESIDENCE LOCATED:
                          MAXIMUM = +100: MINIMUM = -10.
    NEIGHBORHOOD INDEX
    ------------------
    CI OF HOUSING         100-CI      90-CI       70-CI
    RENT/SPACE UNIT         165         150         135
    MS USE INDEX MS USE INDEX - 100: MAXIMUM= 100
    SCHOOL USE   SCHOOL USE INDEX - 100: MAXIMUM= 100
     INDEX
```

THE ECONOMIC SECTOR

Economic teams are given the opportunity and responsibility for operating and creating any growth in the economic resources of the local system. Players in this sector have the chance to use this opportunity in such a way as to satisfy self-established goals and/or to respond to pressures brought on them by government officials, the local citizenry, and the rest of the business community.

The teams in the economic sector represent private owners of land and businesses. An economic team (identified by a single letter A, B, C, etc.) is distinguished from other decision-makers in the model by the fact that it owns private property. Another asset of the economic decision-maker is cash. Teams may use this cash to acquire new land, build new businesses, upgrade old ones or invest in stocks. Economic decision-makers, while concentrating on maximizing their own profit, will find that their decisions, biases and judgments greatly influence the local system.

Economic teams interact with the social sector in that the economic teams employ population units and set salary levels, supply housing quantity and quality, set rent levels, provide personal goods and services for purchase by population units, and set prices. The social teams that control the local system population may take actions against economic teams if they think salaries are too low, rents are too high, housing is in bad shape, or costs are out of line.

Economic teams interact with the government sector in that they require zoning approval, utilities, water supply, and transportation access to undertake certain developments. The government sector, in turn, is dependent in large part on the economic sector for local tax revenue.

Economic decision-maker detailed output

Each of the economic teams receives statistics at the beginning of every round of play that summarize the cash flow for the previous year, a balance sheet showing net worth, loans made and received, new construction completed, boycotts in operation, undeveloped land holdings, and detail on all of its businesses. The team may use any of its resources to achieve whatever objectives it desires.

Financial Summary

Cash flow statement: A team's cash holdings can be used to purchase additional property, construct any of the types of economic sector land uses on property that it owns and which is properly zoned and served with utilities, construct any level or type of effluent treatment plant at a business which it owns, demolish any building it owns, pay off loans, grant a loan to another team, pay taxes on undeveloped land, or spend it in some miscellaneous way (cash transfer to another team and purchase of national stocks).

Additions to the new balance (i.e., cash) come from selling property, receiving payment from loans, receiving loans, investments (developments and farms) in the local economy, government subsidies, interest on savings (interest on savings in 2.5 percent), and from miscellaneous sources (cash transfers from others and sale of national stocks).

If the team makes no decisions during a particular round, it is still charged interest and principal payments on loans and taxes on undeveloped land. The team also automatically receives loan payments, interest on savings, and net income. This latter figure, however, may be a negative number if the developments of a given team are doing poorly and their expenses exceed income.

Investments: The second part of the Financial Summary output shows investments in the national economy. A team may invest as much cash as it wishes in either conservative or speculative national businesses. The national business cycle generates the year by year rate of return for conservative stocks and for speculative stocks. In upswings in the business cycle, the rate of return on speculative stocks will always be larger. The range for the rate of return on conservative stocks is narrow and centers on six percent whereas for speculative stocks the range is wide and it centers on about seven percent. In bad years, however, the return on speculative stocks could be very small or even negative. The return from national investments is automatically used to purchase additional stock. A team must "dis-invest" in order to have returns from national investments show up in the cash account.

Balance sheet: A team's assets include cash on hand, loans to others, the value of investments in the national economy, and the value of developments and land. Developments are valued at their typical construction costs times their value ratio divided by 100. Thus, developments that are not maintained decrease in value over time. Land is priced at the market value.

A team's liabilities are the sum of the principal on all loans from others (indebtedness). Net worth is the difference between current assets and liabilities. Teams may borrow up to 80% of their total assets from national bankers. The amount which a team can borrow from the Outside is shown on the last line of this output. There are no limits on the amount of debt that teams may have among themselves.

```
*****************************************************************
                                    THE CITY
                FINANCIAL SUMMARY--ECONOMIC DECISION MAKER A
*****************************************************************


 CASH FLOW STATEMENT
 -------------------

   PREVIOUS CASH BALANCE               $       273759744.

      EXPENDITURE
           PROPERTY PURCHASED          $               0.
           CONSTRUCTION                $        50000000.
           DEMOLITION                  $       114000000.
           LOAN PAYMENTS               $         6191512.
           NEW LOANS GRANTED           $               0.
           UNDEV LAND TAXES            $        10565400.
           MISCELLANEOUS               $               0.

      INCOME
           PROPERTY SOLD               $               0.
           LOAN PAYMENTS RECEIVED      $         3303121.
           LOANS RECEIVED              $               0.
           TOTAL NET INCOME            $        29469392.
           SUBSIDIES                   $               0.
           INTEREST ON SAVINGS         $         3354805.
           MISCELLANEOUS               $               0.

      NEW BALANCE                      $       129349784.

           CONSERVATIVE INVESTMENTS        $               0.
                INCLUDING A RETURN OF  $               0.
           SPECULATIVE INVESTMENTS         $               0.
                INCLUDING A RETURN OF  $               0.

   TOTAL ASSETS                        $      1174511372.
           CASH                        $       129349784.
           LOANS TO OTHERS             $         2562135.
           INVESTMENTS IN OUTSIDE      $               0.
           DEVELOPMENTS                $       289999572.
           LAND                        $       752379372.


   LIABILITIES (INDEBTEDNESS)          $        72625528.
   NET WORTH                           $      1101885844.

NEW BORROWING CAPABILITY FROM OUTSIDE $       866982656.
```

Loan statement

The loans that a team has with national bankers (Outside = OU) and with other teams are shown in the loan statement. The loans received from other sources are listed and their annual payments summarized. The loans granted to other teams are listed after that. Note that the interest rates may vary by loan.

```
****************************************************************************
                                 TWOCITY
          LOAN STATEMENT--ECONOMIC DECISION MAKER C                 ROUND  2
****************************************************************************
                            INTEREST          REMAINING   ORIGINAL            ANNUAL
BORROWER   LENDER           RATE              YEARS       PRINCIPAL           PAYMENT
--------   ------           --------          ---------   ---------           -------

   C         OU                  3.5                 23   $  75000000      $  4550592

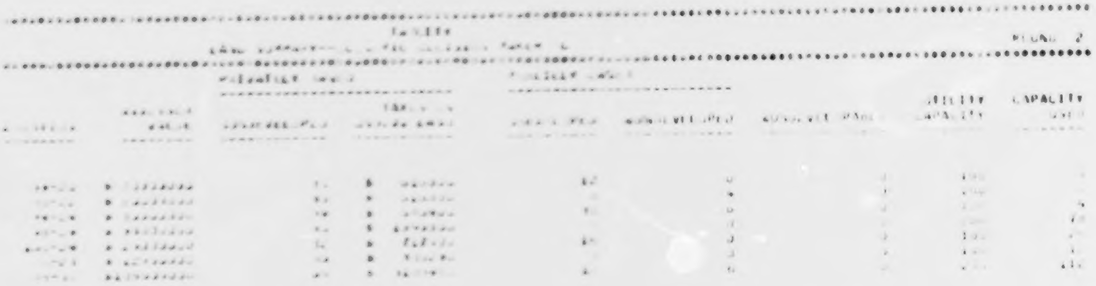
   C         E                   6.5                  8   $  10000000      $   819818
                                                                           ----------
                                                              TOTAL        $  5370410
```

Loans between teams are made for any amount and at whatever interest rate is mutually agreeable. The only conditions on a loan internal to the system is that the period be specified as either 2 or 25 years, and that the lending team have sufficient cash to cover the loan.

An economic team may also borrow money from the outside system for either a 2 or 25 year period. The interest rate is set by the national bankers who take into consideration the national business cycle. An economic team that has debts equalling 80% of its total assets may not receive any further loans from the outside system.

Land summary

The Land Summary output shows the location, by parcel coordinates, of all land owned by a team. It also shows the assessed value of the entire parcel (assuming that 100% of the parcel is valued in the same proportion as the private part), the publicly owned part (percent developed and undeveloped), the undevelopable percent, the number of units of utility service available to that parcel, and the number of utility units used.



Teams may acquire land from other players at mutually agreeable terms or from the director on a bid submission basis. The director represents small farmers and outside land holders who will sell if the price is right. The game director controls the sale of Outside-owned land. The cost of making land bids on Outside-owned properties is set at some percent of the bid amount, regardless of the bid's success or failure.

New construction table

```
**************************************************************************************************************
                                                   TWOCITY
                                    NEW CONSTRUCTION TABLE   --  ECONOMIC DECISION MAKER  A                  ROUN
**************************************************************************************************************

CONSTRUCTION                                     CONSTRUCTION                          RENT/PLI      QUALITY INDEX
    SITE         LAND     OLD      NEW             INDUSTRY              AGREED           OR              OR
  LOCATION       USE     LEVEL    LEVEL            LOCATION               PRICE         SALARIES       PRICE/CU              STATUS

    96-26         CR       1        0                0- 0              $ 90000000      H-$     0                           COMPLETED
                                                                                       M-$     0
                                                                                       L-$     0

    96-28         MF       1        0                0- 0              $ 64000000      H-$     0                           COMPLETED
```

The new construction output shows the location at which a new development or an additional level of development is taking place. It also shows the type of development, the old and new level, the location of the construction firm which is usually stated as 0-0 denoting an outside system firm, the contract price, the rent per space unit (if a residence) or the salary by class (if an employer), the quality index (if housing) or the price per CU (if a store), and the contract status. "Completed" means that the development became operational at the beginning of the round.

Economic boycott

Economic teams may boycott the purchase of goods or services from local BG, BS, PG, and/or PS establishments, and their own businesses can be boycotted by the social sector as a place to work or shop. Boycotts continue in operation for succeeding rounds unless terminated by a decision input on the part of the boycotting team. The boycott output shows the team boycotting, the income class or land use that is carrying out the boycott, and the function being boycotted (work or shop). The boycott output also shows the location and land use being boycotted, and the team owning the boycotted business.

```
*********************************************************************************
      TWOCITY
ECONOMIC DECISION MAKER A          BOYCOTT STATUS OUTPUT          ROUND 2
*********************************************************************************

                    BOYCOTTING                            BOYCOTTED

            CLASS OR
 TEAM       LAND USE        FUNCTION              LOCATION     LAND USE     OWNER

  A            MF             SHOP                  9830          BG          C

  A            FO             SHOP                  9830          BG          C
```

Thus, boycott information appears as part of an economic decision-maker's output if he is boycotting and/or if he is being boycotted.

Residence detail

The Residence Output shows the location, type and level of each residential complex owned by a team. All residences in the model are described as rental units, although the rent on single family housing could be viewed as a form of mortgage payment. Although the construction and operation of housing is a player decision, the process that moves population units into housing is performed by the computer and is affected by player decisions in the economic and governmental sectors.

```
*************************************************************************************************************
                                           TAXCITY
                          ECONOMIC DECISION MAKER 8   RESIDENCE OUTPUT                           ROUND  .
*************************************************************************************************************

LOCATION                          8622        8826        8828        9228        8830        8834        9234
TYPE AND LEVEL                    RA 1        RA 1        RA 4        RA 2        RC 1        RA 3        RB 3
QUALITY INDEX                       50          50          45         100          75          80          70
MAINTENANCE LEVEL                   50          40          55         100          75          80          70
PS DISTRICT                          1           1           1           1           1           1           1
UTILITY DISTRICT                     1           1           1           1           1           1           1

DEPRECIATION (%)
     PS                            0.1         0.1         0.1         1.0         0.1         0.1         0.1
     FIRE                          2.0         2.0         2.0         2.0         4.0         2.0         3.0
     FLOOD                         0.0         0.0         0.0         0.0         0.0         0.0         0.0

WATER CONSUMPTION (MGD)
     MUNICIPAL                     0.0         0.0         0.0         0.0         0.0         0.0         0.0
     OUTSIDE                      0.07        0.30        0.35        0.15        1.08        0.20        1.24

OCCUPANTS                       1M  0H      4M  3H      5M  0H      1M  1H     16M 10H      0M  5H      8M 12H
PERCENT OCCUPANCY                   75         100          99          88          49         100         100
RENT/SPACE UNIT                 135000      161000      159000      140000      161000      160000      161000

 INCOME
     RENT                       177500      960000     1192500      490000     7084000      960000     5796000

 EXPENDITURES
     MAINTENANCE                 38000       35500      121000      121000     2408000      144000      216000
     UTILITIES                   40000      120000      160000       80000     1170000      120000      750000
     WATER                       17640       75600       88200       37800      272160       50400      312480
     PROPERTY TAXES              42075       42250      135890       86720      533370      104950      513090
     INCOME TAXES                54344      391360      404884      134345     2049980      350902     2553360
     SALES TAXES                  1180        2750        3930        3930       18040        4720        7080

NET INCOME                        8261      204030      213590       26205      571850      175044     1413490

RATE OF RETURN                    1.10        7.55        5.41        1.31        2.01        6.44        9.24

ENVIRONMENTAL INDICES
     LOW INCOME                    121         237         231         174         320         217         220
     MIDDLE INCOME                 119         161         159         137         257         150         157
     HIGH INCOME                   120         137         131         137         246         143         146
```

The economic decision maker directly controls the rent of housing and its quality index (by changing the maintenance level). Government decision-makers affect the quality of municipal services and schools serving each residence and the tax rate and welfare rate for the jurisdiction containing each residence. Both government and economic decision-makers affect the water quality on a parcel. All of these factors are taken into consideration by the computer when assigning population units to available housing.

The quality index and maintenance level: The quality index of a residence is a measure of the present value of a development to the best possible value which a residence can have. The Social Sector Master Table (page 92) shows that PH's require a quality index of at least 70, PM's a value of 40, and PL's a value of 20. This does not mean, however, that all Pl's of a given class automatically move out of housing when the quality index falls below the minimum value. They just won't move in, and they tend to move out because of increased dissatisfaction.

The quality index declines each year in response to time, the quality of local municipal services, and increased fire damage due to insufficient water supply, unless maintenance is performed on the residence. The maintenance level indicates the lowest level the owner of the residence will allow the quality index to fall before incurring maintenance expenses. The quality index can be raised above its present level by the player inputting a maintenance level that is higher than the quality index. The quality index may not be raised more than 20 points above the lowest level it has ever reached.

MS district: As was mentioned above, the quality of the municipal services (as measured by the MS use index) serving a residence has an effect on the attractiveness of that residence to potential occupants and on its rate of depreciation. The residence output shows the code number of the municipal service unit that serves each residence. The use index of each MS district is shown on the Municipal Services Report (page 101) and on the Municipal Services Map (page 106). An MS use index value of 101 or more indicates overcapacity and means that the municipal services supplied are less than adequate. As the MS use index increases above 101, the residences served by that MS building become less and less attractive to Pl's and the residences also depreciate at a faster and faster rate. For example, a use index of 150 is twice as bad as a use index of 125 and five times as bad as a use index of 110.

Utility district: Utility districts provide water and sewer services in addition to other utilities. If a district provides an insufficient amount of water for its users' needs, that inadequacy is reflected in an increased depreciation for all economic activities in the district. A water shortage can occur for any of the following reasons: (1) the intake water quality is 9 and, therefore, untreatable; (2) there is insufficient water for all of the users' needs; or (3) the district's intake treatment plant has the capacity to treat less water than its users need. The residence output shows the code number of the utility district serving each residence parcel.

Depreciation: A residence has a normal annual depreciation, depending on its type (see Master Tables, page 137, for depreciation rates). As mentioned above, it can also depreciate due to inadequate municipal services and/or inadequate fire protection. The amount of depreciation due to MS,[*] fire, and flood is printed in percent of the activity's original value, assumed to be 100%.

Water consumption: A residence normally receives all of its required water from a municipal source (its utility district). However, there are two exceptions: (1) when the utility district provides insufficient water for its users' needs; and (2) when a residence is served by private utility service. (It is assumed that they have wells and septic tanks.) They do pay an expense for water, but that amount is paid to the Outside and is lower than the normal Outside price for water. A residence supplied by a municipal water source receives water from Outside only when the local supply is inadequate. When such occurs, each residence receives an amount of water proportionate to its needs. For example, if the needs of all the water users in a utility totaled to 24 MGD and the district was only able to supply 16 MGD (67%), a residence needing 3 MGD would receive 2 MGD from the district (67%).

The amount of water required by a residence is a function of the residence type and class of occupants. In general, a high-income PI uses more water than a low-income PI, and a RA dweller uses more water than an RC dweller. See the Master Tables (page 137) for specific water requirements by class and residence type.

Occupants, percent occupancy, rent/space unit: The residence output shows the number of PI's of each class that occupy every residence. Ph's and PL's may never live together on the same residence parcel. The percent of occupancy is determined by taking the number of PI's by class, multiplying times their residence space consumption index (Social Sector Master Table, page 93), and taking this as a ratio of the total space units in the residence. For example, assume an RA3 has one PH and two PM's occupying it. The PH has a space consumption index of 2 and the two PM's together a space consumption index of 3.00 (2 x 1.50). Thus, there are 5.00 space units being occupied from an RA3 that has 6.00 space units of capacity. The occupancy rate is therefore 5/6 = .83, or the building is 83 percent occupied.

Rents are always specified in terms of the rent paid per space unit. A PM pays 1.50 times the per-space-unit rent, and a PH pays twice as much as a PL.

---

[*] **The MS use index used in the depreciation calculation is last round's use index of the MS serving the parcel this round.**

Income: The income earned by a residential unit is equal to the rent per space unit times the total number of space units occupied. Income earned from a residence is independent of which classes occupy it; income is directly related to the percent which a residence is occupied and the rent being charged.

Expenditures: The owners of residences incur expenditures for maintenance, utilities, water, property taxes, income taxes, and sales taxes. A residence's maintenance expenditure is the sum of its expenditures for personal goods and personal services. The number of consumption units required for maintenance is a function of the total percent depreciation, the level of the residence, and the number of PG and PS units required for each percent depreciation (see Master Tables, page **137**). The normal percent depreciation is also on the Master Tables (page **137**), and depreciation due to other factors is on the residence output (page **103**). Suppose that the RA3 **unit in question** has a normal depreciation of 1% and has 2.5% more depreciation due to the other factors. Total depreciation: 3.5%. If that RA requires .7 PG units and .3 PS units per 1% depreciation and the residence owner has set a maintenance level which offsets that depreciation, the residence's PG consumption is: 3.5 × .7 × 3 = 7.35, or 7 PG units. Its PS consumption is: 3.5 × .3 × 3 = 3.15, or 3 PS units.

The expenditure for *utilities* depends upon the number of utility units consumed by type and level of residence (see the Economic Master Table, page **138**) and the cost per unit of utility service as established by the Utility Department.

Although PI's consume *water*, residence owners pay for the water. Local water prices per million gallons consumed in a year are set by the Utility Department for each economic activity. The prices for residences are set by class and by residence type. The residence owner pays the local price for that amount of water which is obtained from the Utility Department and pays the Outside price for the amount not supplied by the Utility Department (see Master Tables for Outside prices, page **207**).

The pricing is relatively straightforward. For example, suppose an RA3 houses 2 PH and 1 PM. Assume the Master Table shows that, in RA housing, a PH requires .08 MGD (29 MG/year), and a PM requires .07 MGD (25 MG/year). Suppose the total amount of water required by the water users in the utility district is 24 MGD but the district can supply only 16 MGD (67%). The residence output would show .15 MGD obtained from the municipal source (16/24 x (.08 + .08 + .07) and .08 MGD from Outside (.08 + .08 + .07 - .15).

Whereas the daily requirement is used for determining local water sufficiency, the billing is done on an annual basis. Suppose the local price per MG for PH in RA is $450, and that the price per MG for PM in RA is $350. Let the Outside price, which is always the same for all water users, be $700 per MG. Then the residence owner's water expenditure for Outside water is:

8/24 x (29 + 29 + 25) x $700 = $19,366

The proportion purchased daily from Outside is multiplied by the total annual requirement and the Outside cost per MG.

The owner's payment to the local Utility Department is:

16/24 x (29 + 29) x $450 + 16/24 x 25 x $350 = $8700 + 5833 = $14,533

Residences pay *property tax* on the assessed value of the building and the land occupied by the building. The Assessment Department has control over land and building assessments and the Chairman and Council have control over the tax rates which are applied to the assessed value.

Residences pay *income taxes* on the same basis as all other economic businesses -- a state tax of 5% on net income and a federal tax of 22% on the first $25,000 of net income before taxes and of 48% on the rest of net income, after state income taxes.

Residences pay *sales taxes* on the purchases from PG and PS for maintenance. The fixed state sales tax is 3% of PG and PS purchases and the local sales tax is determined by the local sales tax authorities. Sales taxes accrue to the jurisdiction of the commercial establishment and not to the jurisdiction of the residence. State sales taxes are paid on purchases from the Outside system as well as on local purchases.

Net income: The final net income for residences is determined by subtracting all of the listed expenditures from the income derived through rents.

Rate of return: The rate of return is expressed as the ratio of the business's net income to its current value. Current value is the original value of the building times its value ratio (or quality index, in the case of a residence) divided by 100, plus the market value of the land consumed by the building.

Environmental indexes: Residences are filled by PI's in the order of lowest environmental indexes first. The characteristics which contribute to a parcel's environmental index are: quality of the school serving the parcel, quality of the MS serving the parcel, residence quality, residence rent, local tax rates, local welfare payments, and the parcel's pollution index. Some of these factors are weighted differently by each class, so there is one index for each class for each parcel. The lower a parcel's environmental index, the more desirable the parcel to migrating population units. For the exact value of each factor in a parcel's environmental indexes, see the section on the migration output (page 43), "Environmental Indexes."

Basic industry detailed output

The basic industry output shows the location and type of each basic industry owned by a team. A basic industry produces units of output that are sold at national markets and at per-unit prices that are determined by the computer-generated national business cycle. Owners of basic industry should consult the section of the Demographic and Economic Statistics (see page 40) that shows the status of the national business cycle.

```
*******************************************************************************
                                              TWOCITY
                                ECONOMIC DECISION MAKER A    BASIC INDUSTRY OUTPUT
*******************************************************************************

LOCATION                              9826          9632
CONSTRUCTED LEVEL                     NS 1          MP 1
OPERATING LEVEL                       NS 1          MP 1
VALUE RATIO                            100           100
MAINTENANCE LEVEL                      100           100
MS DISTRICT                              3             2
UTILITY DISTRICT                         2             2
DEPRECIATION (%)
    MS                                 3.0           4.0
    FIRE                               0.0           0.0
    FLOOD                              0.0           0.0
    WATER QUALITY                      0.0           0.0
WATER CONSUMPTION (MGD)
    NORMAL SOURCE                     0.18          0.0
    OUTSIDE                           0.0         225.00
PERCENT WATER RECYCLED                   0             0
EFFLUENT TREATMENT
    TYPE AND LEVEL                       0          TT 1
SALARY (PER WORKER IN 100'S)
    HIGH                               100           110
    MIDDLE                              50            55
    LOW                                 25            28
EMPLOYEES
  FULL TIME (IN P1'S)
    HIGH                                 0            19
    MIDDLE                               9            18
    LOW                                  9            18
  PART TIME (IN UNITS)
    HIGH                                80            80
    MIDDLE                               0           160
    LOW                                  0           320
EMPLOYMENT EFFECT                      452          1000
UNITS PRODUCED                         452          1000
PRICE/UNIT OUTPUT                   116500        188300
INCOME
    SALES(PRIVATE)                52658000     188300000
EXPENDITURES
    GOODS                          6000000      14000000
    SERVICES                      23000000       3500000
    MAINTENANCE                    3000000      11200000
    UTILITIES                       760000       7000000
    WATER
      RECYCLING                          0             0
      INTAKE PROCESS                     0             0
      OUTFLOW TREATMENT        -1116871168      17550000
      MUNICIPAL SUPPLY               21060      40949984
    TRANSPORTATION                 2960000      12649497
    SALARIES                      12900000      56320000
    PROPERTY TAXES                 1251000       3804000
    SALES TAXES                     960000        861000
    INCOME TAXES                   2300453      49392570
NET INCOME                         -973450      24072933

RATE OF RETURN                       -1.95         12.11
```

Constructed level and operating level: Of all businesses represented in the model, basic industries alone may decrease their level of operations without demolishing a portion of their buildings. An industry's constructed level is the maximum level at which it may operate. The operating level is the current level at which it is specified to function. The constructed level is considered only when land consumption, maintenance and taxes on the development are calculated. For all other purposes, a business's operating level is the only level considered.

Value ratio and maintenance level: The quality of plant and equipment for businesses is represented by the value ratio. The value ratio is the ratio of present value to original value. Business facilities depreciate every year. The Economic Master Table, (page **134**) shows the annual percent depreciation caused by time, MS quality, and water supply for fire protection. Businesses may overcome this depreciation effect by setting their maintenance levels at points below which they do not want the value ratios to fall. For example, if a maintenance level is set at 100, then that business will make maintenance expenditures every year to keep the building in "like new" shape. The value ratio of a business may be raised above its present value (if less than 100) by inputting a maintenance level that is higher than the value ratio.

MS District: The value ratio of basic industry is lowered by poor municipal services as measured by an MS use index in excess of 100. Basic industry output shows the code number of the municipal service unit which serves the basic industry. MS use indexes are shown on the Municipal Services Department Report (see page **181**) and on the Municipal Services Map (see page **186**). The contribution of the MS use index to value ratio decline is directly proportional to the amount by which the use index exceeds 100. For example, a use index of 150 has double the effect of a use index of 125 and five times the effect of a use index of 110.

Utility District: Utility districts provide water, sewer, and other utilities. If a district provides an insufficient amount of water for its users' needs, the fire protection is inadequate. That inadequacy is reflected in an increased depreciation for all economic activities in the district.

Depreciation: A basic industry has a normal annual depreciation, depending on its type (see Master Tables, page **134**, for depreciation rates). It can also depreciate due to inadequate municipal services and/or inadequate fire protection. The depreciation due to MS and fire is printed in percent of the activity's original value, assumed to be 100%.

Basic industries which use surface water have an additional factor in depreciation: intake water quality. The maximum depreciation due to intake water quality is 1%, for water quality 9. There is no depreciation for quality 1 water.

Water consumption and recycling: Industries that use municipally-supplied water normally receive all of their required water from a local municipal source (the one within their utility district). An industry supplied by a municipal water source receives water from Outside only when the local supply is inadequate. When such occurs, each industry receives an amount of water proportionate to its needs. For example, if the needs of all of the water users in a district totaled to 24 MGD and the district was only able to supply 16 MGD (67%), an industry needing 12 MGD would receive 8 MGD from the district (67% of its needs).

The only businesses which do not use municipal water are those basic industries which use surface water directly. There are two cases in which such a business would not obtain all of its water requirement from the surface water: 1) the total amount attempted removed from the surface water by itself and municipal intake points on its parcel was greater than the amount of surface water on the parcel; or 2) the surface water quality was 9. In the first case, the business would receive an amount of the surface water proportionate to its requirement. In the second case, the industry would purchase all of its water requirement from the Outside.

Basic industries which use surface water can recycle up to 100% of their water. At a recycling level of 100% an industry requires half as much water as normal and has half as much effluent.

Effluent treatment: A basic industry which uses surface water can treat its effluent. A treatment plant can be one of four types: chlorination (CL), primary treatment (PT), secondary treatment (ST), or tertiary treatment (TT). Each of the four types removes a percent of each pollutant, chlorination removing the least and tertiary the most. A treatment plant has a fixed capacity which is a function of its level. Each level of a business's effluent treatment plant has the capacity to treat the effluent generated by one level of the business at a recycling level of zero. For example, a level two treatment plant can treat all of the effluent generated by a business operating at a level two with no recycling. The plant could handle all of the effluent of a business operating at a level four if it had 100% recycling. Any effluent in excess of treatment plant capacity is dumped untreated into the surface water.

Salary: All industries must hire employees in terms of whole population units in order to operate and earn income. However, the actual assignment of PI's to an employment location is performed by the computer. The employer's ability to effect this process is through the manipulation of salaries offered to each income-class. Employee's salaries are expressed in terms of wage per worker and not per PI. Since the number of population units actually hired by an employer is determined by the employment process which takes into account location, transportation, educational level of workers, salary offered and supply of and demand for workers, it is important that employers take into consideration the local labor market situation when setting salary levels.

Employees and employment effect: The number of population units required for a level one development of all businesses is shown in the Economic Master Table (page 182). The number actually hired is shown on the detail business output. Full-time employees are shown in population units (PI's) and part-time employees are shown in time units, where 80 time units is equivalent to a full-time job in terms of income earned.

If a basic industry hires all of the employees it requires, the employment effect is 1000 per level of development. A value of less than 1000 means that either some of the full or some of the part-time employees required from some income class were not hired. It is useful to check the Employment Summary (page 60) and the Part-time Employment Statistics (page 60) if deficiency of employees exists. If a basic industry at level one hires only 80 percent of the PI's it requires, then the employment effect is 800 (i,e., 1000 x .80).

Units produced: The maximum units produced by a basic industry is 1000 per level. If the employment effect is less than 1000 and/or if the value ratio is less than 100 then the units produced will not be at a maximum. The units produced figure is obtained by multiplying the employment effect by the value ratio divided by 100. Thus, if the employment effect were 800 and the value ratio were 90, then the units produced would be 720 (i.e., 800 x .90).

Price per unit of output and income: The price per unit of output for basic industry is determined by the national business cycle price relative and the normal price per unit for the industry type. The actual price per unit of output is the normal price multiplied by the business cycle price relative. Income is the product of the price per unit and the units produced. All sales of basic industry output are to the national system. All output is sold and no inventories are accumulated.

Expenditures: Basic industry incurs expenses for business goods and business services. A fixed amount of BG and BS units are purchased by basic industry by type and level for normal operation, and for the amount of maintenance performed. These expenditures are listed separately under the maintenance category.

The expenditure for *utilities* depends upon the number of utility units consumed by basic industry by type and level (see the Economic Master Table, page 184) and price per utility unit.

There are four types of basic industry expenditures related to *water*: recycling, intake treatment, outflow treatment, and payment for municipal (or Outside) water. Local water prices per million gallons consumed in a year are set by the Utility Department for each economic activity. The prices for industries may be set by type. The industry pays the local price for the amount of water which is obtained from the Utility Department and pays the Outside price for the amount not supplied by the Utility Department (see Master Tables for Outside prices, page 207). See page 207 for an explanation of the water billing process.

A basic industry which uses surface water can incur all four types of expenditures. Recycling and outflow treatment costs are direct functions of the business owner's decisions. The owner can set a recycling level of 0 to 100. A business at 100% recycling requires half as much water as a business at recycling level zero. Likewise, it has half as much effluent. The cost to recycle a million gallons of water is given on the Master Table (page **134**). Suppose a TA required 17 MGD and 4420 MGY for a level one without recycling. Suppose a TA2 has a recycle level of 60%, and the cost to recycle is $200 per million gallons. The TA's annual volume of recycling would be: 4420 MGD x 2 x 0.3 = 2652 MG. The cost for recycling would be: $200/MG x 2652 MG = $530,400.

The business owner also decides what type and level of effluent treatment, if any, the business has. The operating cost of an effluent treatment plant varies by type of treatment and number of MG's treated in a year. Suppose the TA cited above had an ST1 effluent treatment plant and the treatment cost per MG for ST was $200. Since the ST1 can treat only the equivalent of the outflow from a level one business, its capacity would be 4420 MG in a year. The business has 6188 MG of effluent (4420 x 2 - 2652). It pays $200 x 4420, or $884,000 for effluent treatment and 1768 MG are dumped untreated.

A business does not construct an intake treatment plant; it is assumed to treat all of its required water to a usable condition. Intake treatment costs are a function of the intake water quality, the type of business, the volume of water consumed. If the intake water quality of the TA cited above were 3, and if the cost to a TA to treat water quality 3 were $80 per MG, the TA's intake treatment cost would be: (4420 MG x 2 - 2652 MG) x $80/MG = $495,040. There is no cost to treat that portion of water which is purchased from the Outside.

Basic industry pays transportation to BG and BS if the industry purchases these from the local system. The transportation charges are based on the type and level of industry and the least cost distances along the various types of roads. All basic industries except NS also incur transportation costs to the terminal which represents the cost of shipping the units produced to national markets. The transportation costs are a function of type of industry, level, distance travelled to terminal and type of roads. Regardless of the distance travelled, an industry pays a base cost (see Master Tables, page **135**) to travel to each of the three types of destinations. The total transportation cost (C) to a single destination is:

$$C = (U \times B) + [U \times B \times L \times (4 \times T - R)]$$

where U = number of units consumed

B = base cost per unit consumed

L = length of a parcel side in miles

T = number of parcel sides traversed along the least cost route

R = sum of the road types traversed along parcel sides on the least cost route

$U \times B$ is the base cost which the industry must pay.

Salary costs by class are determined by multiplying the salary per worker times the number of workers per PI times the number of PI's hired.

Business pay *property tax* on the assessed value of the development and the land occupied by the development. The Assessment Department assesses the value of land and developments and the Chairman and Council determine the tax rates.

Businesses pay *income taxes* to the Federal and State governments using the rates shown in the Master Table (page **133**).

Businesses pay *sales taxes* on the purchases from BG and BS. There is a fixed state sales tax of 3%. State sales taxes are paid on purchases from the Outside system as well as on local purchases.

Net income and rate of return: Basic industry net income is obtained by subtracting all of the above expenditures from the gross income. The rate of return is the ratio of the business's net income to its current value. Current value is the original value of the building times its value ratio divided by 100, plus the market value of the land consumed by the building.

Commercial establishment detail

The computer output for commercial establishments is slightly different for business commercial (BG and BS) and for personal commercial (PG and PS). The major difference is that BG and BS always purchase their needed supplies from the outside system, whereas PG and PS are able to purchase their goods and services from local BG and BS establishments. Only the most significant differences are discussed below. For an explanation of similar functions, see the previous section on Basic Industry. The commercial output shows the location, type and level of development.

```
*************************************************************************
                                                  TWOCITY
                                  ECONOMIC DECISION MAKER B    COMMERCIAL OUTPUT
*************************************************************************

LOCATION                              9832
TYPE AND LEVEL                        BS 1
VALUE RATIO                             80
MAINTENANCE LEVEL                       80
MS DISTRICT                              2
UTILITY DISTRICT                         2
DEPRECIATION (%)
    MS                                 3.0
    FIRE                               0.0
    FLOOD                              0.0
    USE                                0.0
WATER CONSUMPTION (MGD)
    MUNICIPAL                         0.17
    OUTSIDE                           0.0
SALARY (PER WORKER IN 100'S)
    HIGH                               100
    MIDDLE                              50
    LOW                                 25
EMPLOYEES
  FULL TIME (IN P1'S)
    HIGH                                20
    MIDDLE                               9
    LOW                                  9
  PART TIME (IN UNITS)
    HIGH                                80
    MIDDLE                               0
    LOW                                  0
EMPLOYMENT EFFECT                     1500
CAPACITY USED                          865
EFFECTIVE CAPACITY                    1200
PRICE/CU                            100000


INCOME
     SALES(PRIVATE)               82500000
     SALES(PUBLIC)                 4000000


EXPENDITURES
     SERVICE CHARGES              50170000
     MAINTENANCE                    100000
     UTILITIES                      710000
     WATER                           23715
     TRANSPORTATION                      0
     SALARIES                     36900000
     PROPERTY TAXES                 308100
     SALES TAXES                   1504100
     INCOME TAXES                        0
NET INCOME                        -3196200

RATE OF RETURN                      -37.95
```

Value ratio and maintenance level: The quality of plant and equipment for commercial establishments is represented by the value ratio. Commercial establishments depreciate every year. The Commercial Master Table (page **136**) shows the annual percent depreciation caused by time, MS quality, use, and water supply for fire protection. For an explanation of these functions, see page **104**.

MS district: The value ratio for commercial establishments is lowered by poor municipal services as measured by an MS use index in excess of 100. See page **100**.

Utility district: Utility districts provide water and sewer services in addition to other utilities. See page **107**.

Depreciation: A commercial establishment has a normal annual depreciation, depending on its type. The parameters for the factors in depreciation for commercial establishments can be found on the Commercial Master Tables. (See explanation for Basic Industry depreciation on page **110** above).

Water consumption: Commercial establishments use municipally-supplied water and they normally receive all of their required water from a local municipal source (the one within their utility district). A commercial establishment supplied by a municipal water source receives water from Outside only when the local supply is inadequate. When such occurs, each business receives an amount of water proportionate to its needs. For example, if the needs of all of the water users in a utility totaled to 24 MGD and the district was only able to supply 16 MGD (67%), a business needing 3 MGD would receive 2 MGD from the district (67% of its needs).

Salary: All businesses must hire employees in terms of whole population units in order to operate and produce.

Employees and employment effect: The number of population units required for a level one development of all commercial establishments is shown in the Commercial Master Table (page **136**). The number actually hired by a commercial establishment is shown on the detailed computer output. Full-time employees are shown in population units (PI's) and part-time employees are shown in time units, where 80 time units is equivalent to a full-time job in terms of income earned for a PI.

If a commercial establishment hires all of the employees it requires, the employment effect is equal to the design capacity shown in the Commercial Master Table. A value of less than this design capacity means that either some of the full or some of the part-time employees required from some income class were not hired. It is useful to check the Employment Summary and the Part-time Employment Statistics if deficiency of employees exists. If a commercial establishment at a development level of one hires only 80 percent of the PI's it requires, then the employment effect is 80 percent of the design capacity.

Capacity used and effective capacity: The effective capacity is calculated for commercial establishments by multiplying the employment effect times the value ratio divided by 100. The effective capacity indicates the number of capacity units (CU's) that the commercial establishment can supply to its customers without a strain on plant, equipment, and quality of service.

Capacity used is the number of consumption units that the commercial establishment actually sold to customers in the competitive local market as determined by the commercial assignment process. If the capacity used exceeds the effective capacity, then the commercial establishment undergoes a strain on its plant and equipment that is represented by increased depreciation. BG and BS establishments may sign contracts with local government departments (Schools and Municipal Services) to automatically supply these departments with their needed goods and services. If these two government departments do not make a contract with a local firm, they will purchase from the Outside at greater than normal prices per unit. These government departments can specify a contract with up to three local BG and three local BS establishments. Greater detail on these contracts is given under the description of the government sector (page **183**).

Price per capacity unit (CU): Each commercial establishment sets its own price. Factors that must be taken into account when setting price are location in relation to potential workers, buyers and sellers; competitive establishments; local demand; boycotts; and the typical price. Typical prices are listed in the Economic Master Table (page **136**).

The commercial process assigns customers to commercial establishments on the basis of least cost to the customer per consumption unit, including the customer's transportation cost to get to the commercial establishment. Customers also are given a bias to shop where they shopped the previous year and a bias against shopping at over-crowded establishments. Owners of commercial establishments are encouraged to examine the commercial allocation summary output and the commercial maps to see which stores are serving which customers. A detailed description of this output can be found under the General Output section (p. **24, 62**).

Income: Sales to private customers and sales to government customers are separated for BG and BS, but not for PG and PS since the latter establishments sell to only the private sector. Income is the product of capacity used and price per CU.

Expenditures: BG and BS spend money for service charges which represent purchases from the Outside system. PG and PS spend money for business goods and business services that represent the finished goods and services that they require in order to operate. In both cases, the dollar amount of expenditures for goods and services (service charges) is directly related to the number of capacity units sold. These relationships are shown in the Commercial Master Table (page **136**).

Commercial establishments must pay annual maintenance if the value ratio is to be prevented from declining. BG and BS pay their maintenance to the Outside system, whereas

PG and PS purchase units of BG and BS for the purposes of maintenance. These relationships are also shown in the Commercial Master Table along with the factors that cause depreciation. Remember that overcrowding of commercial establishments causes the depreciation rate to increase. Commercial establishments purchase utilities based upon type and level of development.

There is one type of commercial establishment expenditure for water: payment for municipal (or Outside) water. The prices for commercial establishments determined by the Utility Department may be set by type of establishment. The business pays the local price for that amount of water which is obtained from the Utility Department and pays the Outside price for the amount not supplied by the Utility Department (see Outside System Master Tables, page **207**, for Outside prices).

The pricing is relatively straightforward. For example, suppose a business consumes 1.0 MG per day and 300 MG per year. Suppose the total amount of water required by the water users in its utility district is 24 MGD but the district can supply only 16 MGD (67%). The business output would show .67 MGD obtained from the municipal source and .33 MGD from the Outside. The total amount obtained from both sources equals the total daily amount required by the industry (1.0 MGD). Whereas the daily requirement is used for determining local water sufficiency, the billing is done on an annual basis in proportion to the amount obtained from each source daily.

PG and PS have transportation charges to BG and BS if they purchase locally, BG has transportation to terminal to purchase goods from the Outside system, and BS has no transportation charges. The transportation costs by type of road to the several destinations are given in the Commercial Master Table (page **136**). Transportation costs incurred by commercial businesses are dependent upon the number of units purchased. See page **113** for a detailed discussion.

Salary costs by class are determined by multiplying the salary per worker times the number of workers per PI times the number of PI's hired. Workers per PI varies by class.

Businesses pay *property tax* on the assessed value of the development and the land occupied by the development. The Assessment Department assesses the value of land and developments and the Chairman and Council determine the tax rates. Businesses pay *income taxes* to the Federal and State governments using the rates shown in the Commercial Master Table (page **136**). State income taxes apply to the net income figure before other taxes have been deducted.

Businesses pay *sales taxes* on all purchases of goods and services. There is a fixed state sales tax of 3%.

Net income and rate of return: Business net income is obtained by subtracting all of the above expenditures from the gross income. Net income for commercial establishments can be very volatile because of the competitive aspect of the local market and the individual business's control over pricing.

The rate of return is printed for each business as a percent, expressing the ratio of the business's net income to its current value. Current value is the original value of the building times its value ratio divided by 100, plus the market value of the land consumed by the building.

Farm output

The farm output shows, for each farm, the farm code number, the type of farm, the number of parcels comprising the farm, the total number of percents of parcels comprising the farm, the farm's fertilizer level, the normal income per 1% of that farm (at fertilizer level zero and before local property taxes are deducted), the multiplier on normal income for each of the three other possible fertilizer levels, the actual income per 1% of that farm (before taxes), the total local property tax paid, and the total net income earned from the farm.

```
*****************************************************************************************************************
                                          TABCITY
                    ECONOMIC DECISION-MAKER A     FARM OUTPUT                                                WEEK
*****************************************************************************************************************

  FARM              NUMBER     NUMBER                  NORMAL INCOME    INCOME MULTIPLIER    ACTUAL INCOME
  CODE     FARM       OF         OF       FERTILIZER   BEFORE TAXES    FERTILIZER LEVELS    BEFORE TAXES     TOTAL LAND      TOTAL
 NUMBER    TYPE    PARCELS    PERCENTS      LEVEL      (PER 1% UNIT)     1     2     3      (PER 1% UNIT)     TAX PAID     NET INCOME
 ------    ----    -------    --------   ----------   -------------   ----  ----  ----    -------------    ----------   ----------

   1        F1        6          504          1             1000       1.07  1.12  1.20        1069           10784        528495
   2        F2        6          564          0             1000       1.08  1.16  1.25        1000           11280        552720
   3        F3        3          300          1             1000       1.05  1.09  1.15        1049            6290    [illegible]
```

An economic decision-maker can make two types of decisions regarding farms: set the fertilizer level at each farm; and sell land on farm parcels. The higher the fertilizer level, the higher the net income before taxes and the greater the amount of pollution in the farm's runoff. A farm owner can either sell all of the farmland on a farm parcel to another economic decision-maker (in which case the parcel ceases to be classified as a farm) or sell part of the parcel to a government department.

The farm code number and farm type are fixed at the beginning of a game. They cannot be changed. The number of parcels and percents of parcels comprising a farm can be decreased but not increased by the farm owner. The normal income before taxes per 1% of a farm is also fixed at the start of a game. That income is increased by the multiplier associated with the farm's fertilizer level to yield the actual income before taxes. The assessed value of farm parcels and property tax rates are set by the local government. The number of percents in the farm and the total land tax paid is subtracted from that result to yield the total net income.

Summary information for the economic sector:

Number of levels of economic activity owned by teams

```
*******************************************************************************************************
                                  TWOCITY
                        NUMBER OF LEVELS OF ECONOMIC ACTIVITY OWNED BY TEAMS                   ROUND  1
*******************************************************************************************************

TEAM   PL   SG   MP   MF   ML   EL   TE   FO   TA   PA   CR   MS   BG   BS   PG   PS   CI   RA   RB   RC   UN
----   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --   --

 A      0    0    1    1    0    0    0    0    0    0    1    0    0    0    0    0    0    0    0    0    3

 B      0    0    0    0    0    0    0    0    0    0    0    0    0    1    0    1    0   11    3    1    5

 C      0    0    0    0    0    0    0    0    0    0    0    0    1    0    0    0    0    9    4    1    3

 D      0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0    0   24    7    2    4

 E      0    0    0    0    0    0    0    0    0    0    0    0    0    0    1    0    0   21    1    1    2
```

The table contains one row per economic team and one column for each type of economic activity. Each entry in the table is the number of levels of an activity controlled by an economic team in the simulated region. The last column, *UN*, is the number of undeveloped parcels which the team owns. The table provides a simple summary of how economic decision authority is currently distributed. It may be observed whether certain teams are specializing or not, whether certain types of businesses exist at all in the region, and, in general, how much economic activity is going on.

Economic control summary (one table per economic decision-maker)

This table provides a simplified picture of the status of each business and residence controlled by the team. There is one row per economic activity. The first two columns show the coordinates and type and level of the activity.

```
*******************************************************************
        TWOCITY
   ECONOMIC CONTROL SUMMARY    TEAM G
*******************************************************************

                          PRODUCTION INDEX                     RATE
  PARCEL                         OR                             OF
 LOCATION    ACTIVITY     OCCUPANCY RATE        NET INCOME    RETURN

   9822        RA 2               75                 43963      2.91%

  10224        RA 4               88                185117      5.78%

  10026        RB 2              125                949368     13.19%

   9828        TE 1              100              12503446      6.95%

   9630        PA 1              100              48792194     19.52%

   9432        FO 1              100              41713531     18.14%
```

The third column is the *production index* (if the activity is a business) or the occupancy rate (if the activity is a residence). A residence's occupancy is expressed as a percent of its capacity. A residence can be occupied to 120% of its capacity. The greater the occupancy, the more income earned by the owner from rents. A business's production index is a measure of its actual output or capacity as a percent of its maximum output or capacity. In the case of a basic industry, the index is the number of units it actually produced as a percent of its design capacity. The production index of a commercial establishment is its effective capacity (the amount which it can adequately serve) to its design capacity. A production index of 100 is the highest which a business can have.

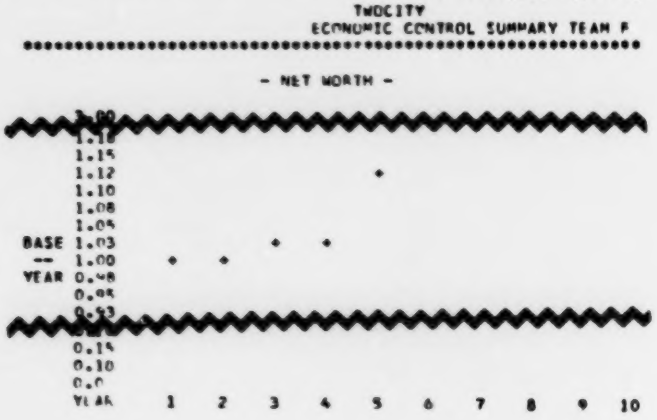
The fourth column, *net income*, is a business's total income from sales or a residence's total income from rents, less operating expenditures.

The last column, *rate of return*, is perhaps the most informative single indicator of an activity's status. Rate of return is the net income as a percent of the development cost, and if a business is doing reasonably well, it usually averages about 10% to 25%. A decision-maker may use rates of return as guides for deciding which activities to emphasize. Further detail on rate of return is contained in the section describing Economic Detailed Output (see page **107**).

Economic Control Summary (two graphs per economic decision-maker)

The two graphs printed for each economic decision-maker show an historical comparison for two types of information: net worth and rate of return. Whereas net worth is the team's total net worth (assets less liabilities), the information on rate of return is the average rate of return of **non-farm** activities controlled by the team. The graphs show the relative values of those items for the most recent ten years. In TwoCity and RAYWID, four years of historical data are loaded. Round 1 is the fifth year on the graph, round 2 is the sixth year, and so on. After 6 rounds have been played (years 5 through 10 on the graph), the data for the earliest year are erased and only data for the most current 10 years are shown. Year 10 is always the most recent round.

On the net worth graph, the team's net worth for each year is shown as a ratio to its net worth in the first year. The first year is always 1.00. The second graph shows the team's average rate of return as an absolute percent, not relative to a base year.


TWOCITY
ECONOMIC CONTROL SUMMARY TEAM F

- NET WORTH -

Economic sector decisions

Summary of possible decisions

The decisions that are available to the Economic Sector decision-makers may be classified into three categories: those specific to a team, those specific to a particular business, and capital expenses. These are outlined below.

Decisions specific to a team:
- Lend money (to other teams)
- Borrow money (from outside bankers)
- Invest or disinvest in stocks (outside system)
- Transfer cash (to social or economic teams or government department)

Decisions specific to a business:
- All businesses:
  - Change maintenance level
  - Boycott
- Residences: Change rents
- Commercial: Change prices
- Commercial and Industrial: Change salaries
- Industrial:
  - Change operating level
  - Construct or demolish effluent treatment plant
  - Recycle water used
- Farms: Change fertilizer level used

Capital decisions:
- Purchase land
- Construct or demolish land use activities

Input format

Local system decision-makers (such as the Economic Sector) use a standardized input form (**next page**) when making decisions that must be processed by the computer.

The standard format for these decisions is:

CODE/=*nn*/*a*, *b*, *c*, . . .

CODE stands for the type of decision code. The Economic Sector has the option to make decisions that use the following decision codes:

$OTHER	(lend and borrow money, invest in or sell stocks)
$CASH	(transfer cash)
$CVPT	(change rents, prices, maintenance levels, salaries)
$BYCT	(boycott)
$[illegible]	(change a business's operating or recycling level)
$WRBLD	(construct or demolish an effluent treatment plant)
$[illegible]	(change a farm's fertilizer level)
$[illegible]	(buy or sell land)
$[illegible]	(construct or demolish an economic activity by the computer. Construction by the computer is immediate, so that the construction project is completed and operational the next year (round)).

"=dm" is the decision-maker, which for the economic sector is "A", "B", "C", etc.

The columns "a", "b", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER BASIN MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$_____ /	=_____ /	_____,	_____,	_____,	_____	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____
$_____ /	=_____ /	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____,	_____

Economic decision-makers: input explanation form

Type of Decision	Code	Decision-maker	a	b	c	d	e
Decisions specific to a team							
Lend money	$OTHER	A, B, C, etc.	LO	amount (in $10,000's)	term (2 or 25)	interest rate (in mils)	borrower
Borrow money	$OTHER	A, B, C, etc.	BO	amount (in $10,000's)	term (2 or 25)		
Invest or disinvest in stocks	$OTHER	A, B, C, etc.	SP, CN, SLSP, SLCN	amount (in dollars			
Transfer cash Note:	$CASH If social recipient put 0 in column "f" and location in column "g"	A, B, C, etc.	C	receiver (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	PVT	if recipient is: economic, PVT; social, H,M, or L; government, CAPital or CURrent account
All businesses							
Change maintenance level	$CVPT	A, B, C, etc.	M	location	new maintenance level		
Boycott	$BYCT	A, B, C, etc.	E	land use boycotting	S	location boycotted	Stop the boycott or Begin it
Residences only							
Change rents	$CVPT	A, B, C, etc.	R	location	new rent per space unit (in $1000's)		
Commercial only							
Change prices	$CVPT	A, B, C, etc.	P	location	price/CU (in 100's)		
Commercial and Industrial							
Change Salaries	$CVPT	A, B, C, etc.	S	location	salary to low income (specified as salary per worker in $100's)	salary to middle income (specified as salary per worker in $100's)	salary to high income (specified as salary per worker in $100's)

Economic decision-makers: input explanation form

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g
Industrial only									
Change the operating level	SENDS	A, B, C, etc.	L	location	New level				
Construct or demolish effluent treatment plant	SWRBLD	A, B, C, etc.	T	location	OUT	Old level	New level	0	New treatment type (CL, PT, ST, TT)
Recycle water used	SENDS	A, B, C, etc.	R	location	percent recycling (0 to 100)				
Farms only									
Change the fertilizer level	SODDS	A, B, C, etc.	F	farm code number	fertilizer level (0-3)				
Capital decision									
Purchase or bid on land	SPU	A, B, C, etc.	location	price (in $1000's)	seller (economic team, or department and jurisdiction or, if bid, OU)	if from department, percent of parcel			
Construct or demolish land use activities	SOUBLD	A, B, C, etc.	location	land use code	Old level	New level	maintenance level	*	*

*f if residence, quality index; if business, salary to PL, worker (in $100's)
*g if residence, 0 or 1 (if private utilities); if business, salary to PM worker (in $100's)
*h if residence, rent per space unit (in $1000's); if business, salary to PH workers (in $100's)
*i if commercial, price per CU (in $100's)

Sample decisions

Decisions specific to a team

Lend money

Team A lends team C $2,000,000 for a period of 2 rounds and at an annual interest rate of 8.5 percent:

Decision Code Decision-Maker ⓐ ⓑ ⓒ ⓓ ⓔ ⓕ ⓖ

$OTHER /: A / L0, 200, 2, 85, C, ___, ___

Team F lends team G $150,000 for a period of 25 years at an annual interest rate of 10.7 percent:

$OTHER /: F / L0, 15, 25, 107, G, ___, ___

Borrow money:

Team B places an application with outside system bankers to borrow $14,000,000 to be paid off during a 25 year period. (This decision will be accepted if this loan does not make Team B's debts rise above 80 percent of its net worth.)

$OTHER /: B / B0, 1400, 25

Invest or disinvest in stocks:

Team A invests $159,000 in speculative stocks:

$OTHER /: A / SP, 159000,

Team B invests $42,550 in conservative stocks:

$OTHER /: B / CN, 42550

Team C disinvests (sells) $452,753 worth of speculative stocks:

$OTHER /: C / SLSP, 452753

Team D sells $35,000 worth of conservative stocks:

$OTHER /: D SLCN, 35000

Transfer cash:

Team E transfers $25,000 in cash to Team F:

$ CASH /: E / C, F, 25000, PVT, PVT

Team E transfers $10,000 in cash to the low-income social living on parcel 9320 and controlled by social decision-maker GG. (Note that social teams are identified for this by a one-lettered name.)

$ CASH /: E / C, G, 10000, PVT, L, O 9320

Team E transfers $2,700,000 to the capital account of the School Department in Jurisdiction 1.

$ CASH /. E / C , SC1 , 2700000 , PVT CAP

Decisions specific to a business:

All businesses:

Change maintenance level:

Team A changes the maintenance level for its RA3 on 9248 from 80 to 85:

CVPT /. B / M , 9248 , 85

Team B changes the maintenance level for its BG on 9632 and for its NS on 10032 to 92. (Note that all the parcel numbers within the parentheses are treated as a single list of information.)

CVPT /. B / M , 9632 , 10032 , 92

Boycott:

Team B has its RA housing boycott the PG establishment at 9232 owned by Team C:

BYCT /. B / E , RA , S , 9232 , B

Team D stops the boycotts that its chemical establishment (CR) had against the BG at 10018:

BYCT /. D / E , CR , S , 10018 , S

Residences:

Change rents:

Team D changes the rent for its RB5 on 11232 from $135,000 per space unit to $147,000 per space unit:

CVPT /. D / R , 11232 , 147

Commercial

Change prices:

Team G changes the price per unit of output sold for its PS at 11438 from $10,000 to $11,500:

CVPT /. G / P , 11438 , 115

Commercial and industrial:

Change salaries:

Team F changes the low-income salaries paid at the BS on parcel 10040 from $2,500 per worker to $2,700 per worker. He leaves the PM salary at $5,000 and the PH salary at $10,000. (Note that the old salaries must be listed on the input form for those income classes whose salaries were not changed.)

$ CNPT /= F / S , [illegible] , 27 , 50 , 100

Industrial:

Change operating level:

Team C wishes to reduce the operating level of its CR3 at 10844 from 3 to 2 and increase the operating level of its MP (which has a constructed level of 3 but a present operating level of 1) at 11040 from a 1 to 2:

$ ENDS /= C / L , 10844 , 2 + $ENDS/=C/L, 11040, 2

Construct effluent treatment facilities:

Team A decides to construct a second level primary treatment facility for its PA3 at 10838:

$ WRBLD /= A / T , 10838 , ØUT , 0 , 2 , 0 , PT

Team F decides to demolish one of the levels of its third level tertiary treatment facility on parcel 9842:

$ WRBLD /= F / T , 9842 , ØUT , 3 , 2 , 0 , TT

Recycle water used:

Team G decides to set a recycle level of 50 percent at its MP2 location 8430:

$ ENDS /= G / R , 8430 , 50 ,

Farms:

Change the fertilizer level used:

Team A decides to change the fertilizer level of its farm (code number 2) from 2 to 0:

$ ODDS /= A / F , 2 , 0 ,

Capital decisions:

Purchase or sell land:

Team A places a bid for $1,000,000 on parcel 11448 which is owned by the outside system. (Successful or not Team A will pay a bid fee just to make the bid.)

$ PU /= A / 11448 , 1000 , ØU ,

Team A purchases all of the privately owned land (and any developments that happen to be on this land) from Team B for $5,600,000.

$ PU /= A / 11038 , 5600 , B ,

Team A purchases 36 percent of parcel 9242 from the Planning and Zoning Department in Jurisdiction 1 for $1,430,000. This land may be used immediately by Team A for any use allowed to Team A.

$ PU /= A / 9242 , 1430 , PZ1 , 36 ,

Construct or demolish land use activities

Team A demolishes an RA5 that was located on 11238. (Assume that Team A also gets the government to rezone the land and supply the needed level of utility service. Team A then constructs a CR1 on the cleared land. The maintenance level for this CR1 is specified to be 100 and the salaries offered are $3,700 for PL workers, $5,400 for PM workers, and $10,500 for PH workers.

$0UBLD/=A /11238, RA, 5, 0

$0UBLD/= A /11238, CR, 0, 1, 100, 37, 54, 105

Team B upgrades (builds more on a parcel that already has some development) the RB2 on parcel 10034 to an RB3 and sets the new maintenance level at 80. The quality index for the new level of housing is 80 (this is averaged with the old quality of the RB2 already there) and the new rent for the entire RB3 is $150,000 per space unit.

$0UBLD/= B /10034, RB, 2, 3, 80, 80, 0, 150

Team C upgrades the BG1 at 9434 to a BG2 and sets the new maintenance level to 70. Salaries are specified as $2,800 per PL worker, $5,200 per PM worker, and $10,600 per PH worker. The price charged for units sold by the BG is set at $107,000 per CU (capacity unit).

$0UBLD/= C /9434, BG, 1, 2, 70, 28, 52, 106, 1070

Economic sector master tables

The numerical values of direct importance to the economic decision-makers are found in five master tables:

(1) Master Table for All Economic Teams (showing information on borrowing and debts, rates of return on stocks, normal price relatives for basic industries, development alternatives, boycotts, and taxes)

(2) Master Table for Industrial Establishments (showing information for all the basic industries including NS)

(3) Master Table for Commercial Establishments (showing information for BG, BS, PG, and PS)

(4) Master Table for Residences (showing information for RA, RB, and RC type housing)

(5) Farm Master Table (showing changes in income as a function of the fertilizer level and the pollution associated with the various fertilizer levels for each of five farm types)

Master table for all economic teams

Limitations on debts	
Maximum amount of debt	80% of net worth
Normal range of outside interest rates	4.3% to 6.2%
Normal range of rates of return on	
Speculative stocks	-1 to 10%
Conservative stocks	5 to 7%
Normal range of price relatives	
Heavy industries	.90 to 1.12
Light industries	.93 to 1.10
National services	.95 to 1.06

Developments (level 1)	Range for Construction Costs (millions dollars)	Range for Land Requirement (percent of a parcel)
Heavy industry		
Surface water users	240-300	28-48
Municipal water users	140-320	12-40
Light industry		
Surface water user	120-250	6-28
National services	50	12
Local commercial	20-45	10-12
Residences (100 quality index)	1-25	2

Economic Boycotts*

Possible Boycotting Activities	Activities that can be boycotted
FL, SG, MP, MF, NL, EL, TE, FO	
TA, PA, CR	
NS, PG, PS	PG, BS
RA, RB, RC	PB, PS

---

* This does not include any social boycotts that might be directed against economic teams. For example, population units may boycott working at any economic employment location or shopping at any PG or PS establishment.

Economic teams

Outside System taxes on all developments

Income taxes:

State - 5% of gross income minus all expenses except water, utilities, transportation, this tax and federal income tax

Federal - 22% of the first $25,000 and 48% of above $25,000 on gross income minus all expenditures except water, utilities, transportation, and this tax

Sales taxes:

3% State sales tax applied against purchases of goods and services (from BG, BS, PG and PS, and purchases from the Outside by BG and BS)

```
                          MASTER TABLE FOR INDUSTRIAL ESTABLISHMENTS
                                 (LEVEL ONE CHARACTERISTICS)

                                FL     SG     MP     MF     NL     EL     TE     FO     TA     PA     CR        NS
LOCATION REQUIREMENTS
*********************
  PERCENT OF PARCEL             28     40     48     20     15     12     12     20      6     16     28        12
  (MAXIMUM POSSIBLE LEVELS)   ( 3)   ( 2)   ( 2)   ( 5)   ( 6)   ( 8)   ( 8)   ( 5)   (16)   ( 6)   ( 3)      ( 8

  ZONING REQUIRED                0      0      0      0      0      0      0      0      0      0      0         0
                                10     10     10     10     10     10     10     10     10     10     10        10
                                20     20     20     20     20     20     20     20     20     20     20        30
                                21     21     21     21     21     21     21     22     22     22     22        31

  MINIMUM LEVEL OF               1      1      7      1      1      2      2      3      1      3      4         1
  UTILITY SERVICE

  ANNUAL UTILITY UNITS          50    100    700    100    100    200    200    300    100    300    400        76
  CONSUMED

  CONSTRUCTION COSTS           300    240    240    320    150    140    180    230    120    250    250        50
  (MILLIONS OF DOLLARS)

DEPRECIATION
************
  ANNUAL PERCENTAGE            3.0    2.0    4.0    3.5    3.0    4.0    5.0    2.0    1.5    1.5    3.0       3.0
  (DUE TO AGING)

  MS EFFECT                    3.0    2.0    4.0    3.0    3.0    4.0    5.0    2.0    2.0    2.0    3.0       3.0
  (MAXIMUM PERCENTAGE)

  FIRE (MAXIMUM PERCENTAGE)    3.0    2.0    4.0    3.5    3.0    4.0    5.0    2.0    1.5    1.5    3.0       3.0

  FLOOD                        DEPENDS UPON AMOUNT INPUT BY DIRECTOR AND LOCATION IN FLOOD PLAIN
    FLOOD MULTIPLIER           0.6    0.6    0.6    0.6    0.6    0.6    0.6    0.5    0.5    0.5    0.5       0.0

  WATER QUALITY (MAXIMUM)      3.5    0.0    3.5    0.0    0.0    0.0    0.0    3.5    3.5    3.5    3.5       0.0

WATER CHARACTERISTICS
*********************
  SURFACE WATER USER             X             X                                   X      X      X      X

  CONSUMPTION (MGD)            61.    10.   225.     9.    12.     5.     8.    49.    17.   333.    31.      0.18

  DAYS IN OPERATION            260    260    260    260    260    260    260    260    260    260    260       260
  PER YEAR

  CONSUMPTION (MGY)          15860   2600  58500   2340   3120   1300   2080  12740   4420  86580   8060        47

  RECYCLING                    200      0    200      0      0      0      0    200    200    200    200         0
    COST PER MG

    MAXIMUM PERCENT OF         100      0    100      0      0      0      0    100    100    100    100         0
    WATER ABLE TO BE
    RECYCLED

  EFFLUENT TREATMENT
  CONSTRUCTION COST
  PER LEVEL
  (MILLIONS OF DOLLARS)
        CL                    0.50   0.0    0.80   0.0    0.0    0.0    0.0    0.45   0.20   1.00   0.30       0.0
        PT                    5.00   0.0    8.00   0.0    0.0    0.0    0.0    4.50   2.00  10.00   3.00       0.0
        ST                   15.00   0.0   24.00   0.0    0.0    0.0    0.0   13.50   6.00  30.00   9.00       0.0
        TT                   45.00   0.0   72.00   0.0    0.0    0.0    0.0   40.50  18.00  90.00  27.00       0.0

EMPLOYEE
********
  FULL TIME POPULATION
UNITS (P1'S)
        PH                       8     14     19     24     21     30     25     15     15     23     24        23
        PM                       8     18     18     18     20     18     22     19     10     17     24         9
        PL                      35     23     18     17     18     17     15     24     30     20     14         9

  PART TIME (LEISURE
  TIME UNITS)
        PH                       0     80     80     80     80     80     80      0      0     80     80        80
        PM                      80    160    160    160     80     80     80     80      0      0     80         0
        PL                     240    160    320    160    160     80     80     80    240    160     80         0

CAPACITY MEASURES
*****************
  MAXIMUM EMPLOYMENT          1000   1000   1000   1000   1000   1000   1000   1000   1000   1000   1000      1000
  EFFECT

  MAXIMUM UNITS PRODUCED      1000   1000   1000   1000   1000   1000   1000   1000   1000   1000   1000      1000
```

```
**********************************************************************************************************

          TWOCITY
        DEMOGRAPHIC AND ECONOMIC STATISTICS                                                     ROUND  2
**********************************************************************************************************

                                                               JURISDICTION   JURISDICTION   JURISDICTION
                                               TOTAL                I              II             III
****************************************    **********         **********     **********     **********

 OTAL POPULATION                               284000             118000         166000              0
                     LOW    CLASS               81000                500          80500              0
                     MIDDLE CLASS               99000              58500          40500              0
                     HIGH   CLASS              104000              59000          45000              0


PERCENT CHANGE OVER PREVIOUS YEAR                   3
AVERAGE POPULATION PER PARCEL                     454                398            504              0

DEVELOPED LAND (IN PARCELS)                        20                  8             11              0
UNDEVELOPED LAND                                  605                288            318              0
TOTAL LAND AREA                                   625                296            329              0

ASSESSED VALUE OF LAND                          9011.              3770.          5242.             0.
    IN MILLIONS

ASSESSED VALUE OF DEVELOPMENTS                   534.               288.           247.             0.
    IN MILLIONS
AVERAGE QUALITY OF LIFE INDEX                     189                170            202              0
NUMBER OF REGISTERED VOTERS                     90601              42819          47782              0
NO. IN PUBLIC ADULT EDUCATION                   64080              18920          45160              0

AVERAGE EDUCATIONAL LEVEL                          58                 74             47              0
      LOW                                          15                 16             15              0
      MIDDLE                                       65                 65             66              0
      HIGH                                         85                 84             87              0


NO. OF WORKERS RECEIVING WELFARE                13040                  0          13040              0

STUDENT/TEACHER RATIO                               3                  3              5              0

SCHOOL ENROLLMENT
      PUBLIC                                    20580               4480          16100              0
      PRIVATE                                   50380              27340          23040              0

HOUSING UNITS
      SINGLE    DWELLINGS                         101                 62             39              0
      MULTIPLE  DWELLINGS                          28                 10             18              0
      HIGH RISE APARTMENTS                          7                  4              3              0

VACANCY RATE       (PERCENT)                        2                  8             -4              0
      NEGATIVE MEANS OVERCROWDED

NUMBER OF EMPLOYED WORKERS                      76000              33080          42920              0
      LOW                                       20200                200          20000              0
      MIDDLE                                    31680              18720          12960              0
      HIGH                                      24120              14160           9960              0



NUMBER EMPLOYED IN
      LIGHT     INDUSTRY                         8760               1520           7240              0
      HEAVY     INDUSTRY                        40080              21480          18600              0
      NATIONAL  SERVICES                         3240                640           2600              0
      CONSTRUCTION INDUSTRY                         0                  0              0              0
      BUSINESS  GOODS                            4400               2320           2080              0
      BUSINESS  SERVICES                         5640                160           5480              0
      PERSONAL  GOODS                               0                  0              0              0
      PERSONAL  SERVICES                         2480                120           2360              0
      MUNICIPAL SERVICES                         5280               3080           2200              0
      SCHOOLS                                    4120               3760            360              0
      RAIL                                          0                  0              0              0
      BUS                                           0                  0              0              0
      FEDERAL-STATE                              2000                  0           2000              0

NUMBER OF UNEMPLOYED WORKERS                    13040                  0          13040              0
      LOW                                       12200                  0          12200              0
      MIDDLE                                        0                  0              0              0
      HIGH                                        840                  0            840              0



UNEMPLOYMENT RATE   (PERCENT)                   14.65                0.0          23.30            0.0
      LOW                                       37.65                0.0          37.89            0.0
      MIDDLE                                    0.0                  0.0          0.0              0.0
      HIGH                                      3.37                 0.0           7.78            0.0


PERCENT EARNING     UNDER $ 5,000                  27                  0             48              0
PERCENT EARNING $5,000 TO $10,000                  40                 56             28              0
PERCENT EARNING     OVER $10,000                   31                 42             23              0
```

```
                 TRANSACTIONS WITH THE NATIONAL ECONOMY
                 **************************************
                 **************************************

INCOME FROM THE NATIONAL ECONOMY
********************************
     FEDERAL - STATE AID RECEIVED

          SCHOOLS   FOR SCHOOL  CONSTRUCTION                       $   0
          SCHOOLS   FOR CURRENT EXPENDITURES                 $ 4,630,500
          MUNICIPAL SERVICES    FOR WELFARE PAYMENTS         $ 5,810,000
          HIGHWAYS              FOR ROAD CONSTRUCTION              $   0

     TOTAL                                                  $ 10,440,500

     SALES TO THE NATIONAL ECONOMY

          HEAVY INDUSTRY             1000 UNITS FOR        $ 188,300,000
          LIGHT INDUSTRY             4568 UNITS FOR        $ 858,239,500
          NATIONAL SERVICES           452 UNITS FOR         $ 52,658,000
          RAIL COMPANY        EQUIPMENT WORTH                      $   0
          BUS  COMPANY          EQUIPMENT WORTH                    $   0

     TOTAL                                               $ 1,099,197,50

TOTAL INCOME FROM THE NATIONAL ECONOMY                   $ 1,109,638,00


EXPENDITURES TO THE NATIONAL ECONOMY
************************************
    FEDERAL - STATE    TAXES

         PERSONAL  INCOME TAX                                     $   0

         CORPORATE INCOME TAX                             $ 320,663,040

         STATE  SALES  TAX                                 $ 19,807,568


         TOTAL                                            $ 340,470,608


    GOODS BOUGHT FROM THE NATIONAL ECONOMY

         BUSINESS GOODS    SERVICE AND MAINTENANCE         $ 59,598,000
         BUSINESS SERVICES SERVICE AND MAINTENANCE        $ 124,772,868

         RAIL COMPANY      EQUIPMENT WORTH                        $   0
         BUS  COMPANY      EQUIPMENT WORTH                        $   0

         DUE TO LOCAL INSUFFICIENCY
              PERSONAL GOODS                              $ 230,347,000
              PERSONAL SERVICES                            $ 29,549,000
              BUSINESS GOODS                               $ 98,020,000
              BUSINESS SERVICES                             $ 1,690,000

         AUTOMOBILE EXPENDITURES                        $ 1,231,045,540
         LAND PURCHASES FROM OUTSIDE WORTH                        $   

         TOTAL                                          $ 1,775,022,40

    TOTAL EXPENDITURES TO THE NATIONAL ECONOMY          $ 2,115,493,01

NATIONAL ECONOMY BUSINESS CYCLE                        ROUND  2
********************************                       ********

          GROSS INCOME RATE OF HEAVY INDUSTRY            1.08

          GROSS INCOME RATE OF LIGHT INDUSTRY            1.07

          GROSS INCOME RATE OF NATIONAL SERVICES         1.05

          AVERAGE OUTSIDE LOAN RATE                      5.20

          AVERAGE RETURN ON CONSERVATIVE INVESTMENTS     6.30

          AVERAGE RETURN ON SPECULATIVE INVESTMENTS      9.20

          AVERAGE BOND RATE                              3.20
```

MASTER TABLE FOR RESIDENCES
(LEVEL ONE CHARACTERISTICS)

```
                                                      RA     RB     RC

LOCATION REQUIREMENTS
*********************
     PERCENT OF PARCEL CONSUMED                        2      2      2

     (MAXIMUM POSSIBLE LEVELS OF                    (50)   (50)   (50)
     DEVELOPMENT)

     ZONING REQUIRED                                   0      0      0
                                                       0      0      0
                                                      40     40     40
                                                      41     42     43


     MINIMUM LEVEL OF UTILITY                          1      1      2
     SERVICE REQUIRED

     (ANNUAL UTILITY UNITS                          (  4)  ( 26)  (117)
     CONSUMED)


CONSTRUCTION FACTORS
********************
     COST (MILLIONS OF DOLLARS)                        1      6     25

     MINIMUM CONSTRUCTED QUALITY INDEX                40     40     40


DEPRECIATION
************
     ANNUAL (DUE TO AGING)                           2.0    3.0    4.0

     MS EFFECT (MAXIMUM)                             1.0    1.0    1.0

     FIRE (MAXIMUM)                                  2.0    3.0    4.0

     FLOOD (MAXIMUM DEPENDS UPON DAMAGE SET BY DIRECTOR AND LOCATION
           ON FLOOD PLAIN)

     (FLOOD MULTIPLIER)                              1.1    1.0    0.9


WATER CONSUMPTION (DEPENDS UPON OCCUPANTS)
*****************
     MGY PER PH                                       29     25     22

     MGY PER PM                                       25     18     11

     MGY PER PL                                       11     11      7
     NUMBER OF DAYS DURING YEAR
     WATER IS USED                                   360    360    360
     MGD PER PH                                     0.08   0.07   0.06
     MGD PER PM                                     0.07   0.05   0.03
     MGD PER PL                                     0.03   0.03   0.02

OCCUPANTS
*********
     SPACE UNITS PROVIDED                              2     12     50

     SPACE UNITS DEMANDED:
             PH                                      2.0    2.0    2.0
             PM                                      1.5    1.5    1.5
             PL                                      1.0    1.0    1.0


RENT PER SPACE UNIT (THOUSANDS OF DOLLARS)
********************
     MAXIMUM                                         210    210    210

     NORMAL FOR VARIOUS CLASSES
             PH                                      165    165    165
             PM                                      150    150    150
             PL                                      135    135    135
```

MASTER TABLE FOR RESIDENCES (CONTINUED)
(LEVEL ONE CHARACTERISTICS)

```
                                                        RA      RB      RC
INCOME (ASSUMING 100% OCCUPANCY)
****** (THOUSANDS OF DOLLARS)
     AT MAXIMUM RENT                                    420    2520   10500

     AT RENT OF $15,000 PER SPACE UNIT
          RH OCCUPANTS                                  300    1800    7500
          RM OCCUPANTS                                  300    1800    7500
          RL OCCUPANTS                                  300    1800    7500


EXPENDITURES
************
     MAINTENANCE:
          RC UNITS PER 1% MAINTENANCE                   0.7     4.0    17.0
          RS UNITS PER 1% MAINTENANCE                   0.3     2.0     8.0
          NORMAL TOTAL COSTS PER 1%                     10      60     250
            MAINTENANCE (THOUSANDS)

     NORMAL UTILITIES CHARGES                           40     260    1170
     (THOUSANDS OF DOLLARS)

     TAXES
       PROPERTY (LOCAL RATE TIMES ASSESSED VALUE)
       INCOME (FEDERAL-STATE TAX)
       SALES (LOCAL RATE TIMES PURCHASES FOR MAINTENANCE)

NET INCOME                        INCOME FROM RENT MINUS EXPENDITURES
**********

RATE OF RETURN                    NET INCOME DIVIDED BY SUM OF RESIDENCE
**************                    VALUE AND LAND VALUE

ENVIRONMENTAL INDEXES             COMPRISED OF POLLUTION INDEX PLUS
*********************             RESIDENCE QUALITY, RENT, MS AND SCHOOL
                                  USE INDEXES, AND TAXES OF WELFARE
```

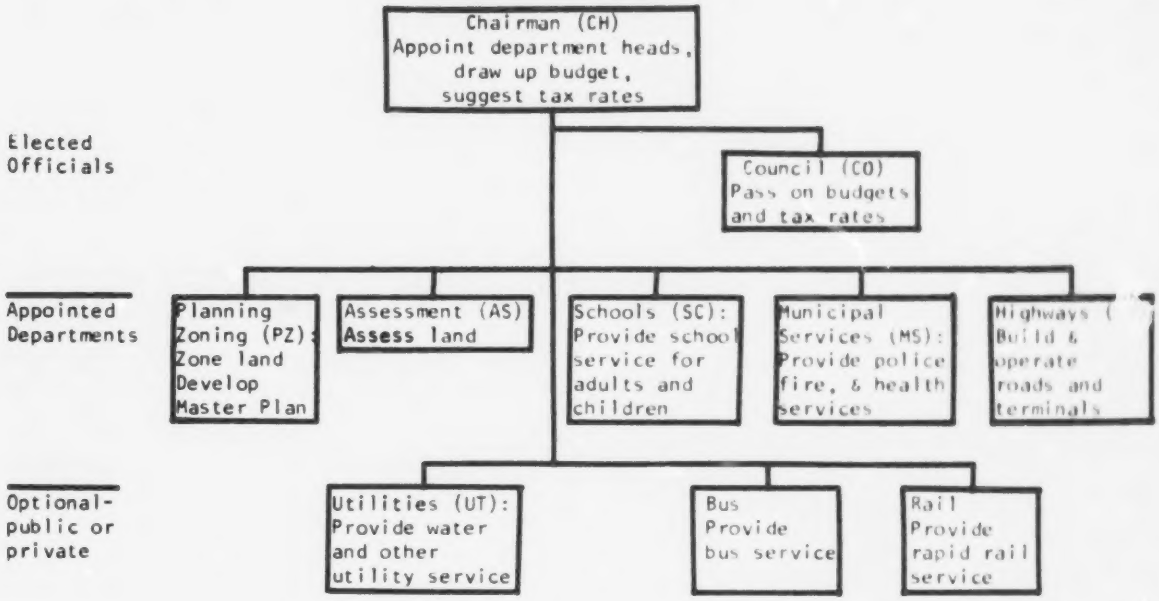
FARM MASTER TABLE

Farm Identification		F1	F2	F3	F4	F5
Percent increase in net income as a function of the fertilizer level:	1	7	8	5	3	2
	2	12	16	9	7	5
	3	20	25	15	12	9
Pollution of nutrients (in Lbs/Mg) as a function of the fertilizer level	0	40	50	30	20	10
	1	80	100	60	40	20
	2	160	250	90	80	30
	3	320	500	180	160	60

THE GOVERNMENT SECTOR

The Government Sector represents the management apparatus for the public sector of the area represented by the model. Participants in this Sector are the elected and appointed public officials. The Government Sector can make public policy, implement plans and programs, provide public services and raise and disperse funds. The model is sufficiently flexible that the sector can be operated using strong central control or somewhat autonomous departments as determined by the participants. There is a separate government apparatus for each of the political jurisdictions represented by the model. Thus, intergovernmental cooperation and competition may evolve during the play.

Government Structure


Chairman (CH)
Appoint department heads,
draw up budget,
suggest tax rates
Elected Officials
Council (CO)
Pass on budgets and tax rates
Appointed Departments
Planning Zoning (PZ): Zone land Develop Master Plan
Assessment (AS) Assess land
Schools (SC): Provide school service for adults and children
Municipal Services (MS): Provide police fire, & health services
Highways (
Build & operate roads and terminals
Optional-public or private
Utilities (UT): Provide water and other utility service
Bus Provide bus service
Rail Provide rapid rail service

Sector functions

The preceding figure shows the government structure that may exist in each of the local systems. The Bus and Rail departments are systemwide functions, whereas the other departments operate on a jurisdiction basis. As noted, the Chairman (or Mayor) and Council are elected in each of the jurisdictions, and the department (staff) decision-makers are appointed by the chairman. The optional public departments, Utilities, Bus, and Rail are usually part of the Government Sector, as quasi-public functions, but they can also be operated as private (economic) sector activities either initially or as a result of participant action (public sale).

Elected officials are accountable to the electorate (the social sector). They are required to respond to public hearings, propose and defend referenda on certain issues, and stand for election. The manner in which elected officials exercise power and conduct their administration and public affairs, however, is at their discretion.

Appointed department representatives are responsible to the Chairman and Council. However, the presence or absence of effective leadership and communication may influence this relationship and staff decisions. The Government Sector decision-makers depend for their political life on the votes of the social sector. Their relationship with the business community is determined by their own view of public office and public service.

Administrative (non-decision) functions:

Any number of additional administrative functions can be created to approximate local structures or to examine a variety of administrative mechanisms. While these optional functions do not make direct input decisions to the computer, they may be created to have as much advisory, regulatory or "legal" influence as the participants (or Director) determine. An Environmental Quality Control Commission, for instance, could be established to act as a regulatory agency in the area of water quality and as such could influence current economic activities and future development.

Government decisions:

The Government Sector decisions cover a wide spectrum of municipal and public service activities. The types of possible decisions and those responsible for making them are listed in the following chart. Complete descriptions are in each decision-maker's manual.

Government Sector Decisions

Type of Decision	Primary Interest Group								
	CH CO	AS	SC	MS	HY	PZ	UT	BU	RA
Grant appropriations	x								
Grant subsidies	x								
Transfer cash	x		x	x	x	x	x	x	x
Set welfare Payments	x								
Set tax rates	x								
Float bonds–capital	x								
Assess land, buildings		x							
Buy and sell land			x	x	x	x	x		x
Establish government jobs			x	x				x	x
Establish maintenance levels of government facilities			x	x	x			x	x
Establish service districts			x	x			x		
Request federal/state aid			x		x				
Establish employee salaries			x	x				x	x
Build and demolish schools			x						
Establish adult education programs			x						
Build and demolish municipal service plants				x					
Contract to purchase goods and services			x	x					
Construct and demolish roads					x				
Construct and demolish terminals					x				
Zone land						x			
Create and demolish public institutional land uses						x			
Provide parkland						x			
Install utility services							x		
Set utility service prices							x		
Construct and demolish utility plants							x		
Locate public transit routes								x	x
Buy and sell rolling stock								x	x
Set fares								x	x

Government Sector Decisions (cont.)

Type of Decision	Primary Interest Group CH CO	AS	SC	MS	HY	PZ	UT	BU	RA
Establish amount of transit service								x	x
Construct rail lines and stations									x
Set water prices							x		
Construct treatment plants (intake and outflow)							x		
Specify intake and outflow points							x		
Establish water sampling stations							x		

Government output:

It rarely happens that the government has all the information it wants, or needs, to make perfect decisions. Many decisions, under pressures of time, will be typical "guesstimates" - intuitive actions. It is possible, however, for each activity to develop an effective information system using the available resources in the model.

For the local system, the general output is usually posted each round and makes available to each participant, in maps, detail and summary form, extensive current and comparative information about conditions, trends and characteristics of the region. The range of information in the maps and the items of General Output cannot be overemphasized. Experience with the model has indicated that decisions are facilitated if the participants use the General Output information as part of their decision process.

Government budgetary procedures

The same general financial accounting procedure is used for all government departments, including Utilities, Bus and Rail. Department budgets are divided into Capital and Current accounts. Departments may transfer funds from one account to another. Appropriations, subsidies, and cash transfers to departments must be directed to either the capital or current account.

The Chairman's account has only a current account, the Planning and Zoning Department has only a capital account, and the Assessment Department has no financial accounts. All other departments have both accounts.

The Chairman makes appropriations and subsidies from his current account before he actually receives income to his account. His is the only department which makes expenditures before income is calculated. Once a department has received an appropriation, the money is never automatically transferred back to the Chairman's account. If the Chairman spends more than he later receives in revenue, a current bond is automatically floated in the Chairman's name and is paid off from the Chairman's account. If a department spends more than its revenues (this can only happen in a department's current account), a current bond is floated in the department's name and is paid off from the department's account.

The following format is contained within each account: Previous cash balance; Revenues; Expenditures; New cash balance. If the output is for round T, then Previous cash balance would be equal to the New cash balance for round T-1.

Expenditures may not be made from capital accounts unless there is sufficient cash to cover the expenditure. Therefore, the cash balance in a capital account is always greater than or equal to zero; it may not be negative. If expenditures from the current account are greater than previous balance plus revenues, then a short term bond (current or two-year) is automatically floated to cover the deficit. Therefore, the New cash balance may never be negative in the current account. Because of rounding, the New cash balance will normally be slightly positive (rather than zero) even in the case where a short-term bond had to be floated.

All capital expenditures are player or director decisions which have been submitted during the previous *EDIT* phase. Current expenditures are made according to government policies which may have been established in any previous *EDIT*. Current expenditures (except miscellaneous expenditures) do not directly reflect player decisions; they are functions of policies. For example, a player sets the salaries and number of job openings which the School Department offers, but other local conditions influence how many employees the department actually hires and thus influence the amount which the department pays in salaries.

The most common capital revenue sources for departments are appropriations (for MS, SC, HY, and PZ), capital bonding for 25 years (all departments), Federal-State Aid (SC, HY) and miscellaneous sources (sale of land, and incoming cash transfers). Special capital revenue sources are subsidies to the Utility Department. The most common capital expenditures are for construction, land purchase, and miscellaneous (outgoing cash transfers).

The most common current revenue sources are appropriations (all but UT and CH), short-term bonding, Federal-State Aid (MS and SC), and miscellaneous income (incoming cash transfers). Special current revenue sources exist for the Utility Department (income from user charges on utility and water service and subsidies) and the Chairman (taxes).

The most common current expenditures are for bond payments (capital bonds and current bonds together), goods and services (MS, SC, maintenance for HY, and utility operating costs for UT), salaries (MS and SC), and miscellaneous (outgoing cash transfers). Special current expenditures are for welfare payments (MS), adult education (SC), treatment operating costs and sampling station operating costs (UT), and subsidies (CH).

CHAIRMAN

Introduction:

The local jurisdictional chief executive is given the opportunity and responsibility for making major budget and public policy decisions for his jurisdiction. The Chairman team will have the chance to use this job in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by department heads, the local citizenry and the business community. Once the players comprising the Chairman team have become familiar with the model in general, the particular city being represented, and the workings of the local government and fiscal system, they will be able to bring their own imagination and initiative to bear on the operation of the Chairman's role in their specific jurisdiction.

Each political jurisdiction has a chief executive (the Chairman) and may or may not have a council that provides checks and balances on the Chairman. The Chairman's office is an elected office, and periodic elections are held in which the members of the Social Sector vote for nominated candidates. The voting power of each social team is dependent upon the number and type of population units under their control and upon the registered voters patterns that have developed as the result of time-allocation in political activity.

The Chairman makes departmental appointments to the local government departments. He also sets budget policy (expenditure and revenue) decisions. Expenditures may take the form of capital or current appropriations, subsidies, cash transfers, and/or welfare payments. Revenue sources over which the Chairman exercises a major influence are local taxes by type and capital bonds. The local government may also receive Federal-State aid, but this is channeled directly through the appropriate departments (SC, MS, or HY). To control his departments, the Chairman may make replacements in department leadership when he feels that he is not getting the support or quality performance he expects.

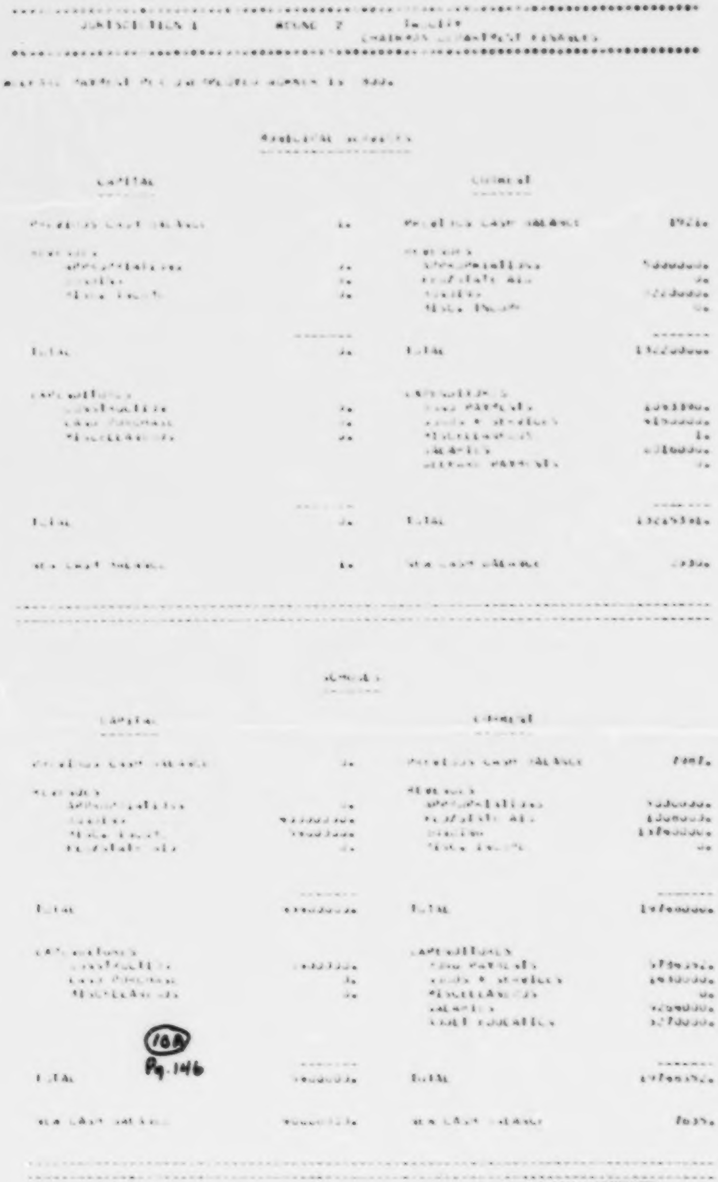
Chairman output

The Chairman output consists of three sections which summarize the revenues and expenditures of all departments and of the jurisdiction's government as a whole.

Chairman department finances

The first line of this output shows the welfare payment rate, which is set by the Chairman. The rest of the output summarizes the revenues and expenditures of each department in the Chairman's jurisdiction: Municipal Services, Schools, Highways, Planning and Zoning, Utilities, and Chairman. Bus and Rail are interjurisdictional and their finances do not appear on the Chairman's report.

The Chairman can grant appropriations to Municipal Services, Schools, Highways and Planning and Zoning. He can grant subsidies to Utilities, Bus and Rail, and he can transfer cash to any account. Further detail on departments' accounts is included in the descriptions of their output.



(10B)
Pg. 146

NOTE: WE HAVE OMITTED THE HIGHWAY, THE PLANNING AND ZONING, AND THE UTILITIES SUMMARIES

Tax summary

This output shows the revenue which the Chairman account receives from each type of local tax formally included in the model. There are four types of local taxes in the model: property, income, automobile, and sales. The Chairman specifies the rate at which these taxes are to be levied and the computer automatically collects the tax revenue. If the Chairman does not set tax rates for a given round, the computer collects taxes at the previous rate.

There are two types of property taxes: land and developments. Land tax is applied to all privately owned land. The tax paid is determined by multiplying the percent of a parcel privately owned times the assessed value of the parcel (set by the Assessment Department) times the land tax rate. Development tax is applied to economic land uses. The tax payment is determined by multiplying the assessed value of a development times the development tax rate.

A political jurisdiction may tax the personal income of either the people who live there or the people who work there. Income tax is paid by a population unit and is determined by multiplying the income tax rate times gross wages of people who live or work in a jurisdiction. Automobile taxes can also be levied by a particular jurisdiction on the people who live there and the people who work there. Automobile tax is determined by multiplying the automobile resident tax rate or the automobile employee tax rate times the travel cost to work by automobile of the people who live in the jurisdiction.

Sales taxes are levied on all purchasers of personal goods and personal services. There are separate tax rates for goods and services. The tax is determined by multiplying the sales tax rate on goods/services in the jurisdiction in which the seller is located times the amount of purchase of goods/service at each seller.

Financial Summary

This output summarizes the cash flow which is itemized on the Chairman Department Finances output.

Summary of decisions

The Chairman is responsible for the coordination and direction of the expenditure of the various departments under his jurisdiction. The only control he has over these funds once he appropriates them to the departments is the control he establishes in the gameroom. In addition, the Chairman is able to appropriate funds to the economic, social and government sectors in the form of subsidies, and to unemployed population units in the form of unemployment compensation. The Chairman is also responsible for establishing policy with regard to revenue sources; that is, acquiring funds for his jurisdiction. He

```
                         CHAIRMAN'S ACCOUNTING
                         ---------------------

                                CURRENT
                                -------

               PREVIOUS CASH BALANCE          54157296.
               REVENUES
                 TAXES                        80200144.
                 NEW BONDING                         0.
                 MISCELLANEOUS                75883174.

                                              --------
               TOTAL                         156083318.

               EXPENDITURES
                 APPROPRIATIONS               40000000.
                 SUBSIDIES                    12000000.
                 BOND PAYMENTS                       0.
                 MISCELLANEOUS                       0.
                                              --------
               TOTAL                          52000000.

               NEW CASH BALANCE              158240614.

               THERE ARE NO OUTSTANDING BONDS

  ***********************************************************************
      JURISDICTION 2     TWOCITY
        ROUND  2                      T A X   S U M M A R Y
  ***********************************************************************
ITEM                                BASE             RATE             REVENUE

PROPERTY TAX LAND               $ 1310251776.    3.5 PERCENT   $      45858816.
             IMPROVEMENT        $  246090992.    4.5 PERCENT   $      11074095.
RESIDENT INCOME TAX             $  466291200.    3.5 PERCENT   $      16320188.
EMPLOYEE INCOME TAX             $  565303296.    1.0 PERCENT   $       5653032.
RESIDENT AUTOMOBILE TAX         $   37780128.    1.0 PERCENT   $        377802.
EMPLOYEE AUTOMOBILE TAX         $   38957952.    1.0 PERCENT   $        389580.
GOODS SALES TAX                 $          0.    2.0 PERCENT   $             0.
SERVICES SALES TAX              $   52670000.    1.0 PERCENT   $        526700.

TOTAL REVENUE                                                  $     160400288.
```

```
****************************************************************************************************
                                        TWOCITY
                      F I N A N C I A L   S U M M A R Y                     JURISDICTION 1     ROUND  2
****************************************************************************************************

                            APPROPRIATIONS           FEDERAL        OTHER        TOTAL        TOTAL      SURPLUS
                                                                                                           OR
      DEPARTMENT          CAPITAL     CURRENT      STATE  AID       INCOME      REVENUE     EXPENSES     DEFICIT

MUNICIPAL SERVICES              0     5000000              0      8220000     13222531     13219390        3141

SCHOOL DEPARTMENT               0     5000000        1008000     59140000     99755635     27278352    72477283

HIGHWAY DEPARTMENT              0     1000000              0     20760000     21768881     21756348       12533

PLANNING AND ZONING             0           0              0            0            0      2000000    -2000000

CHAIRMAN                        0    11000000              0            0     35853808            0    35853808

   TOTAL                        0    22000000        1008000     88120000    170600855     64254090   106346765
```

11A
Pg. 149

has two general sources available; taxes and bonding.

The expenditure and revenue decisions available to the Chairman from each jurisdiction are as follows:

Appropriation and expenditure decisions:

- -- Current appropriations
- -- Capital appropriations
- -- Grant subsidies
- -- Cash transfer
- -- Welfare payment level

Revenue decisions:

- -- Land tax
- -- Developments tax
- -- Income tax
- -- Auto tax
- -- Sales tax
- -- Float capital bonds

The following chart shows the eligibility of different types of recipients for appropriations, subsidies, and cash transfers from the Chairman.

	Appropriations:		Subsidies:		Economic	Cash
	Current	Capital	Current	Capital	Subsidy	Transfer
SC	x	x				x
MS	x	x				x
PZ		x				x
HY	x	x				x
BUS			x	x		x
RAIL			x	x		x
UT			x	x		x
ECONOMIC TEAMS					x	
INCOME CLASS ON A PARCEL						x

Any appropriations not spent by the departments remain in their accounts and do not revert back to the Chairman's account. All of the Chairman's appropriations to the Government Departments remain at the last level's input to the computer. Therefore, if the Chairman made an input of $10 m to the current account of the School Department in round t, then the School Department would receive the same amount in round t+1 unless the Chairman states otherwise. Likewise tax rates and unemployment payments continue at their old levels until changed.

Subsidies, cash transfers, and capital bonds, on the other hand, are one-round decisions. They do not automatically continue from one round to the next.

Input format

Local system decision-makers (such as the Chairman) use a standardized input form when making decisions that must be processed by the computer.

The standard format for these decisions is:

$CODE/ =dm/a, b, c, . . .

$CODE stands for the type of decision code. The Chairman has the option to make decisions that use the following decision codes:

$CASH (appropriations, subsidies, cash transfers)
$OTHER (welfare payment, capital bonds)
$TAXES (tax rates)

"*=dm*" is the decision maker, which for the Chairman is *CH1*, *CH2*, or *CH3* depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the decision-maker code, even if there is only one active jurisdiction.

The columns "*a*", "*b*", and so forth are filled in with the appropriate information depending upon the particular decision.

Remember that *CH*, *AS*, *SC*, *MS*, *PZ*, *HY*, and *UT* must always be followed by a jurisdiction number. On the other hand, *BUS* and *RAIL* never have a jurisdiction number after them.

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER BASIN MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____

Chairman: input explanation form

Expenditure decisions	Code	Decision Maker	a	b	c	d
Grant capital appropriations	$CASH	CH1, CH2 or CH3	CP	department receiving and jurisdiction	amount (in dollars)	
Grant current appropriations	$CASH	CH1, CH2 or CH3	CR	department receiving and jurisdiction	amount (in dollars	
Grant subsidies	$CASH	CH1, CH2 or CH3	if department receiving, CURS, or CAPS; if economic team receiving, SB	department receiving and jurisdiction or economic team receiving	amount (in dollars)	
Transfer cash	$CASH NOTE: If social recipient put "0" in column "f" and residence location in column "g"	CH1, CH2 or CH3	C	receiver (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	CUR
Set welfare payments	$OTHER	CH1, CH2 or CH3	W	amount per unemployed worker (in $100's)		
Revenue Decisions						
Change land tax rate	$TAXES	CH1, CH2 or CH3	L	land tax rate (in mils)		
Change development tax rate	$TAXES	CH1, CH2 or CH3	D	development rate (in mils)		
Change resident (or employee) income tax rate	$TAXES	CH1, CH2 or CH3	RI or EI	tax rate (in mils)		

Revenue Decisions	Code	Decision Maker	a	b	c	d
Change resident (or employee) auto tax rate	STAXES	CH1, CH2 or CH3	RA or EA	tax rate (in mils)		
Change PG or PS sales tax rate	STAXES	CH1, CH2 or CH3	G or S	tax rate (in mils)		
Float capital bonds	SOTHER	department receiving and jurisdiction	BO	amount (in $10,000's)	25	

e: if economic decision-maker receiving, [illegible]; if social, L, M, or H, if department receiving, CAPital or CURrent account

Sample decisions

Appropriation and expenditure decisions

Current appropriations - The Chairman of Jurisdiction 2 grants a current appropriation to the Highway Department of $500,000.

Decision Code **Decision-Maker** a b c d e f g

$ CASH / = CH2 / CR , HY2 , 500000, ____, ____, ____, ____

Capital appropriations - The Chairman of Jurisdiction 1 grants a capital appropriation to the Municipal Service Department of $40,000,000.

$ CASH / = CH1 / CP , MS1 , 40000000, ____,

Current government subsidy - A grant of a subsidy to the current account of the Utility Department is given by the Chairman of Jurisdiction 3.

$ CASH / = CH3 / CURS , UT3 , 6000000, ____,

Capital government subsidy - The Chairman of Jurisdiction 1 grants a subsidy of $50,000 to the capital account of the Bus Department.

$ CASH / = CH1 / CAPS , BUS , 50000 , ____,

Subsidy to economic sector - The Chairman of Jurisdiction 1 grants a subsidy of $10,000 to Economic Decision-Maker B.

$ CASH / = CH1 / SB , B , 10000, ____,

Cash transfer - The Chairman in Jurisdiction 2 makes cash transfers of $25,000 to the current account of the School Department of Jurisdiction 2, $150,000 to the capital account of the Highway Department in Jurisdiction 3, $10,000 to Team A, and $31,000 to the low-income population units on parcel 9430 controlled by Team FF.

$ CASH / = CH2 / C , SC2 , 25000, CUR , CUR , ____, ____

$ CASH / = CH2 / C , HY3 , 150000, CUR , CAP , ____, ____

$ CASH / = CH2 / C , A , 10000, CUR , PVT , ____, ____

$ CASH / = CH2 / C , F , 31000, CUR , L , O , 9430

Setting welfare payment - The welfare payment for unemployed workers in Jurisdiction 2 is set at $2,100.

$ OTHER / = CH2 / W , 21 , ____,

Revenue decisions

Tax rate on land - The Chairman in Jurisdiction 1 sets the real property tax rate on land at 5.0 percent.

Decision Code	Decision-Maker	a	b	c
$TAXES /	= CH1 /	L ,	50 ,	____

Tax rate on developments - The tax rate on real property developments is set at 7.3 percent in Jurisdiction 2.

$TAXES / = CH2 / D , 73 , ____

Resident income tax rate - The resident income tax rate in Jurisdiction 3 is set at 3.2 percent and the employee income tax in Jurisdiction 1 is set at 4.1 percent.

$TAXES / = CH3 / RI , 32 , ____

$TAXES / = CH1 / EI , 41 , ____

Tax rate on automobile use - Jurisdiction 3 imposes a 1.2 percent tax on automobile expenditures to work by residents of the jurisdiction and a 2.6 percent automobile tax on employees who work in the jurisdiction.

$TAXES / = CH3 / RA , 12 , ____

$TAXES / = CH3 / EA , 26 , ____

Tax rate on goods - In Jurisdiction 2 the tax rate levied on personal goods sold is 1.0 percent.

$TAXES / = CH2 / G , 10 , ____

Tax rate on services - In Jurisdiction 2 the tax rate on personal services is changed to 1.5 percent.

$TAXES / = CH2 / S , 15 , ____

Floating capital bonds - The Chairman in Jurisdiction 3 decides to float a $6,000,000 bond for Capital improvements for the Highway Department in Jurisdiction 3. (Note that the Chairman does not use his own decision-maker code but that of the recipient department).

$OTHER / = HY3 / B0 , 600 , 25

MASTER TABLE FOR THE CHAIRMAN

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	(Maximum Possible Levels)	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees PH	PM	PL	Terminal Units	MS Drain (MS Capacity Units)
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

OPERATION OF FEDERAL-STATE AID

Department	Basis			Limit on Number of Requests per Jurisdiction	Probability of Receipt
School					
Current Aid	$225/student			N.A.	Automatic (no request needed)
Capital Aid	Match dollar for dollar			3	60% (1st request) 40% (2nd request) 30% (3rd request)
		Matching			
Highways	Type of Road	Federal	Local		
Capital Aid	I	$1	$9	5 road segments	80%
	II	$1	$1		50%
	III	$2	$1		30%
Municipal Services					
Current Aid	Two Federal-State dollars for each local dollar up to maximum total paid of $35 per resident of the jurisdiction			N.A.	Automatic

GOVERNMENT SUMMARY TABLE

(Characteristics are for Level One Development)

	SC	MS	UT	HY	TM	RAIL STATION	RAIL TRACKS (Per Mi) SURFACE	RAIL TRACKS (Per Mi) UNDER-GROUND	VEHICLES RAIL	VEHICLES BUS
CONSTRUCTION COST (Millions of Dollars)	27	30	30	2M	14	1	4	NA	.8/mi	.4/mi
DEMOLITION COST (Millions of Dollars)	5.4	6	6	.4 M	2.8M	NA	NA	NA		
CHARACTERISTICS OF FACILITIES										
Possible Levels of Development	3	3	3	3	3	1	1	1		
Land Requirement (% of a parcel)	16	12	20	8	12	NONE	4	NONE		
Rate of Annual Depreciation (%)	2.0	3.3	NA	5.0	NA	NA	NA	NA	3.5	3.5

	SC	MS	UT	HY	RAIL	BUS	PZ
POSSIBLE SOURCES OF REVENUE TO DEPARTMENTS							
Current Funds							
Appropriations	x	x					
Subsidy			x		x	x	
Cash Transfer	x	x	x	x	x	x	
Automatic Bonding	x	x	x	x	x	x	
Automatic Federal State Aid	x	x					
Capital Funds							
Appropriations	x	x		x			
Subsidy			x		x	x	x
Cash Transfer	x	x	x	x	x	x	x
Bonding	x	x	x	x	x	x	x
Federal-State Aid	x			x			
Charges to Users			x		x	x	
Labor Hired	PH PM	PM PL	NA	NA	PM	PM	NA

Assessment department

The Assessment Department is given the responsibility for determining assessed values of property. It will have the chance to use this job in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials, the local citizenry and business community.

Once the players comprising the Assessment Department have become familiar with the model in general, the particular city being represented, and the workings of the local government and fiscal system they will be able to bring their own imagination and initiative to bear on the operation of the Assessment Department in their specific jurisdiction.

The largest percentage of the revenues raised by local governments is from the real property tax. This tax is calculated by multiplying the tax base (the value of all real property) times the tax rate:

Base x Rate = Tax

The tax rate is set by the Chairman. It is the responsibility of the Assessment Department to calculate the tax base. The value of real property in the model is determined by the normal workings of supply and demand. It is called market value and varies according to the purchase price of the specific parcel. Persons who purchase land take into account the value of the proximity of transportation access, the availability of adequate Utility and Municipal Services facilities, the type of zoning restrictions, and the pattern of residential and/or commercial-industrial developments in the area surrounding the parcel.

The Assessment Department does not, therefore, determine value but it does determine what percentage of the total market value of a specific parcel will be used in the calculation Base x Rate = Tax. To do this the Department focuses on three properties of market value: (1) property type, (2) property components (land and developments), and (3) property location.

The Assessment Department may assess land and/or developments at any rate from zero to one hundred percent of their market value. The department may alter the total assessible tax base by changing the assessment ratio across the board, changing it selectively, or changing assessments on specific parcels of land. The decision-maker for the Assessment Department in each jurisdiction is appointed by the Chairman of that jurisdiction.

Assessment department output

As in all roles, the Assessment Department not only interacts with all of the other users of the model in the Economic, Social, and Government Sectors but with the computer as well. The computer output used by the Assessment Department exclusively can be broken up into two general types: tabular and maps

Tabular output:

The tabular output of each jurisdiction shows the current assessment ratios for the jurisdiction as a whole and any exceptions to these jurisdiction-wide assessment ratios.

```
*********************************************
                JURISDICTION 2      TWOCITY
            ASSESSMENT REPORT
*********************************************

ASSESSMENT RATIOS  (PERCENT OF MARKET VALUE)
---------------------------------------------

LAND ON UNDEVELOPED PARCELS            50.0
LAND ON DEVELOPED PARCELS              50.0



  BUSINESS TYPE:         RA            50.0
                         RB            50.0
                         RC            50.0
                         LI            50.0
                         HI            50.0
                         NS            50.0
                         CI            10.0
                         BG            50.0
                         BS            50.0
                         PG            50.0
                         PS            50.0
   FARM TYPE:            F1            15.0
                         F2            15.0
                         F3            15.0

XCEPTIONS TO JURISDICTION-WIDE RATIOS
--------------------------------------
               LOCATION    RATIO (%)
               --------    ---------
DEVELOPMENT:    NONE


NON-FARM LAND:  NONE


FARM LAND:      NONE


DOLLAR VALUE
 BUILDING:      NONE


DOLLAR VALUE
 LAND:          NONE


DOLLAR VALUE FARM:          NONE
```

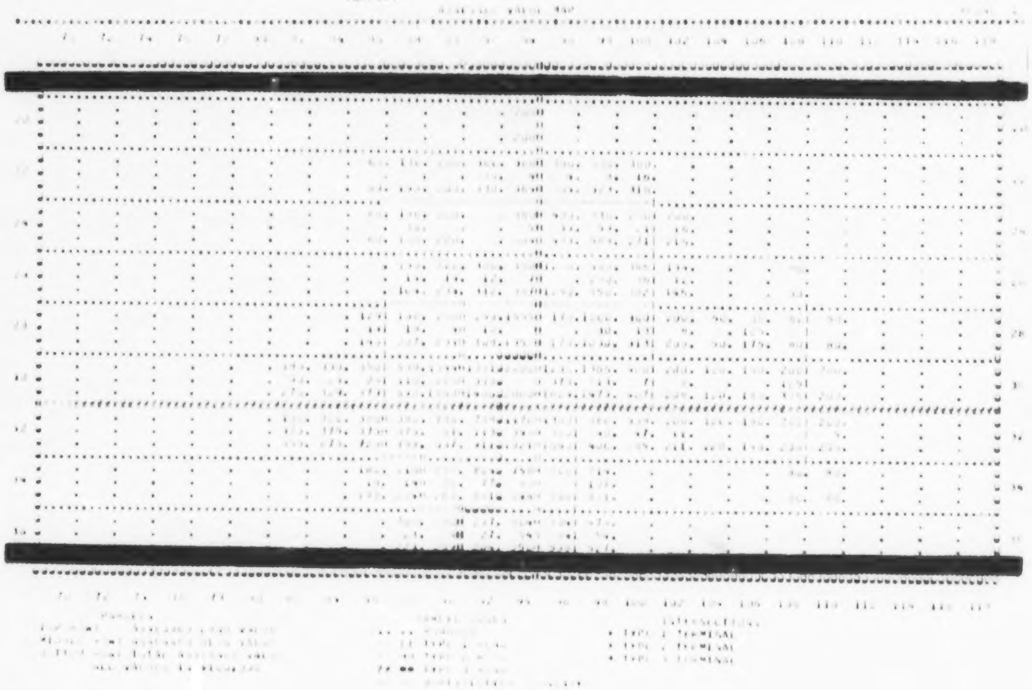
The first portion displays the overall assessment ratio for all properties in the jurisdiction. Assessment ratios may vary for land that is on developed parcels and land that is locally owned but on undeveloped parcels. Developments may be assessed by development type. Likewise each of the farm types may be assessed at different rates.

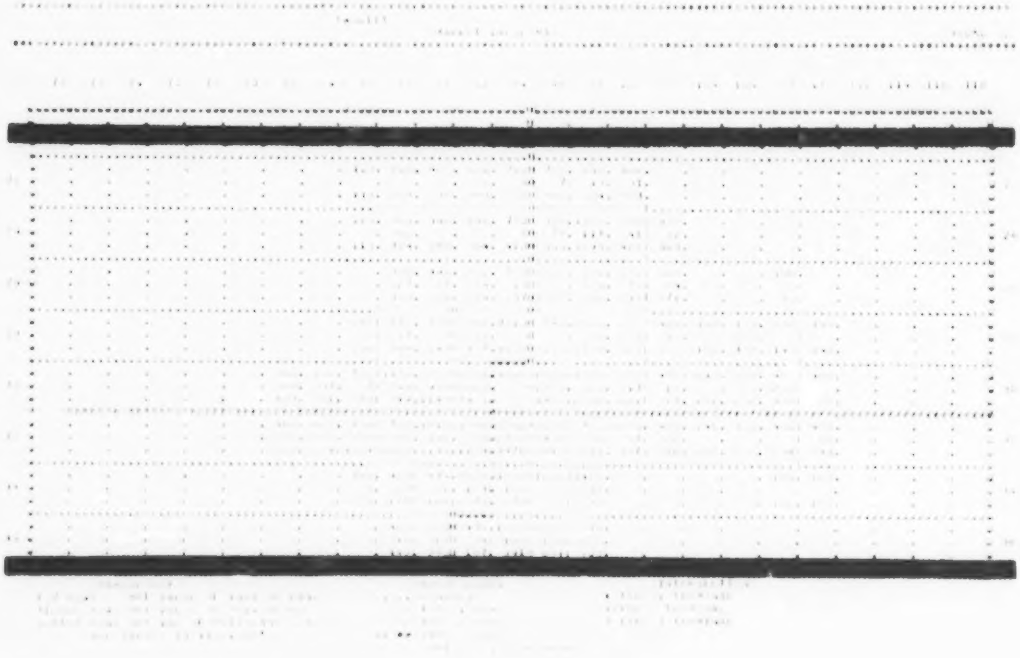
The second portion lists any exceptions to these jurisdiction-wide ratios. The parcel number is listed and the specific assessment ratio is given in percentage terms for developments (land use need not be specified since there is only one private land use allowed per parcel), non-farm land, and farm land. The Assessment Department may wish to make specific dollar assessments (instead of assessment rates) for particular parcels of land. These are the last three categories on the tabular output: building (developments), land (non-farm land) and farms.

Map output:

There are three maps of primary interest to the assessor. These maps supplement the printed matter discussed above and are used to plan the assessment strategy for the jurisdiction. The maps are: (1) Market Value Map, (2) Assessed Value Map, and (3) Farm Assessed and Market Value Map.

Other maps may also be of use to the Assessment Department. These include the Economic Status, Utility, and Planning and Zoning maps.


100 102 104 106 108 110 112 114 116 118
INTERSECTIONS
TYPE 1 TERMINAL
TYPE 2 TERMINAL
TYPE 3 TERMINAL



Assessment Department Decisions:

The three factors considered by the Assessment Department in determining real property value for tax purposes are: (1) property type, (2) property components (land and developments), and (3) property location.

Property type -- In the model there are four general categories of land use; industrial, commercial, residential, and farmland. There are further breakdowns in each of these categories:

Industrial:
HI = Heavy industry
LI = Light industry
NS = National services

(The manufacturing types included under the HI and LI categories are shown in the Assessment Master Table, page 168).

Commercial:
BG = Business goods
BS = Business services
PG = Personal goods
PS = Personal services

Residential:
RA = Single family housing
RB = Town houses, garden apartments
RC = Highrise apartment buildings

Each of these land-use types can be assessed for a different (or the same) percentage of their market value. This percentage is called an assessment ratio. Remember, the market value is not set by the Assessment Department. The department is only responsible for determining the percentage of this value (whatever it is) that will be used as part of the real property tax base. This procedure allows the local government to encourage (or discourage) certain land use types by regulating the relative real property tax they will pay.

Property components -- For assessment purposes, privately owned property can be thought of as having two separable components of value; land and developments.

Land value is usually only of significance for those privately owned parcels which have not been developed (built upon). However, for certain purposes the Assessment Department might wish to set the land value of specific properties or of land in specific locations. The model provides for both opportunities. The market value of land is determined by the most recent sale price (as long as it is not less than 80 percent of the prior sale price). Land that is exchanged between teams at a zero cost maintains its previous market value.

The market value of developments is determined by the type and level of development and the value ratio. The assessment ratio of buildings, if set differently by land-use type, can be a factor in encouraging (or discouraging) certain types of development.

Property location -- The final determinant of property value is location. Many times the local governments will wish to encourage (or discourage) growth in certain areas under their jurisdiction. Further, they may wish to give a subsidy (or levy a penalty) on land uses in specific areas.

This can be done in two ways in the model: first, by locating the parcel(s) for special treatment and second, by setting either a specific assessment ratio for the parcel or a specific dollar value for assessment purposes.

Input format

Local system decision-makers use a standardized input form when making decisions that must be processed by the computer.

The standard message format is:

$CODE/= dm/a, b, c, d, . . .

$CODE stands for the type of decision code. The Assessment Department has the option to make decisions that use the following decision code:

[illegible]

"=dm" is the decision-maker, which for the Assessment Department is AD1, AD2, or AD3 depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the AD decision-maker code even if there is only one active jurisdiction.

The columns "a", "b", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER BASIN MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____ /	=____ /	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____

Assessment department: Input explanation form

Type of decision	Decision code	Decision Maker	a	b	c
Jurisdiction-wide assessment ratio:					
Developments	SASMNT	AS1, AS2 or AS3	two-letter land use code (RA, RB, RC, HI, LI, NS, BG, BS, PG, PS)	ratio in tenths of a percent	
Land	SASMNT	AS1, AS2 or AS3	UL or DL	ratio in tenths of a percent	
Farms	SASMNT	AS1, AS2 or AS3	FR for all farmland or F1, F2. . .F11 for specific farm type	ratio in tenths of a percent	
Parcel-specific assessment ratio:					
Developments	SASMNT	AS1, AS2 or AS3	AD	ratio in tenths of a percent	location
Land	SASMNT	AS1, AS2 or AS3	AL	ratio in tenths of a percent	location
Farms	SASMNT	AS1, AS2 or AS3	AF	ratio in tenths of a percent	location
Parcel-specific dollar assessments					
Developments	SASMNT	AS1, AS2 or AS3	SD	assessed value in $100,000's	location
Land	SASMNT	AS1, AS2 or AS3	SL	assessed value in $100,000's	location
Farms	SASMNT	AS1, AS2 or AS3	SF	assessed value in $100,000's	location

Sample assessment decisions

Assessment decisions are classified by scope (jurisdiction-wide or parcel-specific) and by type (on developments, land, or farms). Jurisdiction-wide decisions apply to all parcels within the boundaries of a jurisdiction.

Jurisdiction-wide (assessment ratio):

- Developments (by land use type)
- Land (on developed or non-developed parcels)
- Farms (by farm type)

Parcel-specific (assessment ratio or dollar amount):

- Developments
- Land
- Farms

Setting assessment ratios jurisdiction-wide:

Developments - Jurisdiction 1 assesses heavy industry developments at 40% of their market value and business goods establishments at 80%.

Decision Code **Decision-Maker** a b c

$ASMNT/ - AS1 / HI, 400, ____,
$ASMNT/ - AS1 / BG, 800, ____,

Land - Jurisdiction 3 assesses land that is developed at 90% of its market value and land that is undeveloped at 45% of its market value.

$ASMNT/ - AS3 / DL, 900, ____,
$ASMNT/ - AS3 / UL, 450, ____,

Farms - Jurisdiction 2 assesses all farmland at a rate of 42.5% and Jurisdiction 1 assesses Farm Type 1 at 45.5% and Farm Type 2 at 37.5%.

$ASMNT/ - AS2 / FR, 425, ____,
$ASMNT/ - AS1 / F1, 455, ____,
$ASMNT/ - AS1 / F2, 375, ____,

Setting assessment ratios for specific parcels:

Developments - Jurisdiction 2 decides to make the assessment ratio for the development on parcel 9438 equal to 59.5%.

$ASMNT/ = AS2 / AD, 595, 9438,

Land - Jurisdiction 1 decides to assess the land on parcels 9030 and 9230 at 42.7%.

$ASMNT/ = AS1 / AL, 427, (9030, 9230),

Farms - Jurisdiction 3 decides to assess the four parcel type 3 farms on parcels 10848, 10850, 11048 and 11050 to 25.0%

$ASMNT/ = AS3 / AF, 250, (10848 > 11050),

Setting dollar assessments for specific parcels:

Developments - Jurisdiction 1 decides to assess the development at 9040 at $31,000,000.

$ASMNT/ = AS1 / SD, 310, 9040,

Land - Jurisdiction 1 decides to assess the land at 9040 at zero.

$ASMNT/ = AS1 / SL, 0, 9040,

Farms- Jurisdiction 3 decides to assess the farm parcel at 11648 at $700,000. (Note that dollar assessment must be made in multiples of $100,000).

$ASMNT/ = AS3 / SF, 7, 11648

Order for decisions:

The order in which the assessment decisions are input to the computer is very important. All systemwide decisions within a jurisdiction should precede any parcel-specific decisions. For example, a systemwide decision to assess all H1 developments at 95 percent of their market value should precede the decision to specially assess the H12 development on parcel 9242 at 75 percent of market value. If the special assessment were entered first, the systemwide decision would negate it.

Undeveloped land:

The UD (undeveloped land) code refers to the land or parcels that are privately owned and have no private development on them. It is not the undeveloped portion of a parcel that has a private development on it.

Dollar assessment decisions:

All dollar amount assessments decisions are of a one-year duration. That is, the parcels and developments take on the desired dollar assessment only for the current year. If the Assessment Department wishes to keep the dollar assessment indefinitely, it must input the dollar assessment decisions each round. All of the other types of assessment decisions remain in force until changed.

MASTER TABLE FOR THE ASSESSMENT DEPARTMENT

Development Types	Market Values of New Level One Developments (millions of dollars)
Manufacturing	
HI - Heavy Industry	
FL - Furniture and Lumber	300
SG - Stone and Glass	240
MP - Primary Metals	240
MF - Fabricated Metals	320
NL - Nonelectrical Machinery	150
EL - Electrical Machinery	140
TE - Transportation Equipment	180
LI - Light Industry	
FO - Food	230
TA - Textiles and Apparel	120
PA - Paper	250
CR - Chemical, Plastics and Rubber	250
Non-Manufacturing Businesses	
NS - National Services	50
BG - Business Goods	25
BS - Business Services	10
PG - Personal Goods	30
PS - Personal Services	10
Residences	
RA - Single Family	1
RB - Garden Apartments	6
RC - High-rise Apartments	25

Other Assessment Codes:

Jurisdiction-Wide Assessment Ratios:
- UL = Undeveloped Land
- DL = Developed Land
- FR = All Farms
- Fn = Type of Farm (F1, F2....)

Parcel Specific Assessment Ratios:
- AD = Developments
- AL = Land
- AF = Farms

Parcel Specific Dollar Assessments:
- SD = Developments
- SL = Land
- SF = Farms

Setting assessment ratios for specific parcels:

Developments - Jurisdiction 2 decides to make the assessment ratio for the development on parcel 9438 equal to 59.5%.

```
$ASMNT/ - AS2 / AD, 595, 9438,
```

Land - Jurisdiction 1 decides to assess the land on parcels 9030 and 9230 at 42.7%.

```
$ASMNT/ = AS1 / AL, 427, (9030, 9230),
```

Farms - Jurisdiction 3 decides to assess the four parcel type 3 farms on parcels 10848, 10850, 11048 and 11050 to 25.0%

```
$ASMNT/ = AS3 / AF, 250, (10848 > 11050),
```

Setting dollar assessments for specific parcels:

Developments - Jurisdiction 1 decides to assess the development at 9040 at $31,000,000.

```
$ASMNT/ = AS1 / SD, 310, 9040,
```

Land - Jurisdiction 1 decides to assess the land at 9040 at zero.

```
$ASMNT/ = AS1 / SL, 0, 9040,
```

Farms- Jurisdiction 3 decides to assess the farm parcel at 11648 at $700,000. (Note that dollar assessment must be made in multiples of $100,000).

```
$ASMNT/ = AS3 / SF, 7, 11648
```

Order for decisions:

The order in which the assessment decisions are input to the computer is very important. All systemwide decisions within a jurisdiction should precede any parcel-specific decisions. For example, a systemwide decision to assess all HI developments at 95 percent of their market value should precede the decision to specially assess the HI2 development on parcel 9242 at 75 percent of market value. If the special assessment were entered first, the systemwide decision would negate it.

Undeveloped land:

The UD (undeveloped land) code refers to the land on parcels that are privately owned and have no private development on them. It is not the undeveloped portion of a parcel that has a private development on it.

Dollar assessment decisions:

All dollar amount assessments decisions are of a one-year duration. That is, the parcels and developments take on the desired dollar assessment only for the current year. If the Assessment Department wishes to keep the dollar assessment indefinitely, it must input the dollar assessment decisions each round. All of the other types of assessment decisions remain in force until changed.

Planning and Zoning Department

The local Planning and Zoning Department is given control of a number of regulatory resources within the local dynamic system and it will have the opportunity to use these powers in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials and the local citizenry and business community.

The Planning and Zoning (PZ) Department performs a function in the local jurisdiction that is as powerful and creative as the persons running it. The department has the responsibility and opportunity to affect land use decisions through its power to zone. A zoning map is in existence when play begins, but the department may modify this or start from scratch if it wishes.

The PZ Department is also responsible for providing adequate parkland and public institutional land for the local jurisdiction population. Parkland is open space recreational areas that have very small capital improvements. Any land that is owned by the PZ Department that is undeveloped is classified as parkland. Public institutional land is parkland that has been developed. The development represents museums, zoos, libraries, public golf courses, etc., that are used by the local population.

Population units in a jurisdiction allocate leisure time to recreational activities. Each one percent of a parcel devoted to public institutional land provides twice as much recreational supply as an equivalent amount of land devoted to parkland.

Figure PZ-1 shows how the Planning and Zoning Department fits into the local government structure.

Planning and zoning department report

This one-page output summarizes the amount of parkland and public institutional land provided by the department and the financial status of the department. The department has the power to purchase land for parks and to develop parkland into public institutional (museums, zoos, etc.) land uses. Park facilities affect where people select housing.

The department also has the power to zone land to restrict what types of economic developments can be constructed on specific parcels. The department can greatly affect the pattern and rate of growth in the jurisdiction.

Further details on Planning and Zoning are contained in the description of the maps which most directly relate to this department.

```
*****************************************************************************
                              JURISDICTION 2      TWNCITY
                                 PLANNING & ZONING DEPARTMENT REPORT
*****************************************************************************

THE POPULATION IS  135000

TOTAL PARKLAND 1520.00 SQUARE MILES

TOTAL INSTITUTIONAL LAND IS 0.250 SQUARE MILES

POPULATION PER SQUARE MILE OF INSTITUTIONAL LAND IS 540000     (NATIONAL
                                                                AVERAGE
                                                                IS 100000)

THERE ARE NO OUTSTANDING BONDS

          FINANCIAL ACCOUNTING

   PREVIOUS CASH BALANCE          3000000.

   REVENUES
        APPROPRIATIONS            3000000.
        BONDING                         0.
        MISCELLANEOUS             4002000.

                                  -------
   TOTAL                          7002000.

   EXPENDITURES
        PUBLIC INSTITUTIONS       4000000.
        BOND PAYMENTS                   0.
        LAND PURCHASE                4000.
        MISCELLANEOUS                   0.

                                  -------
   TOTAL                          4004000.

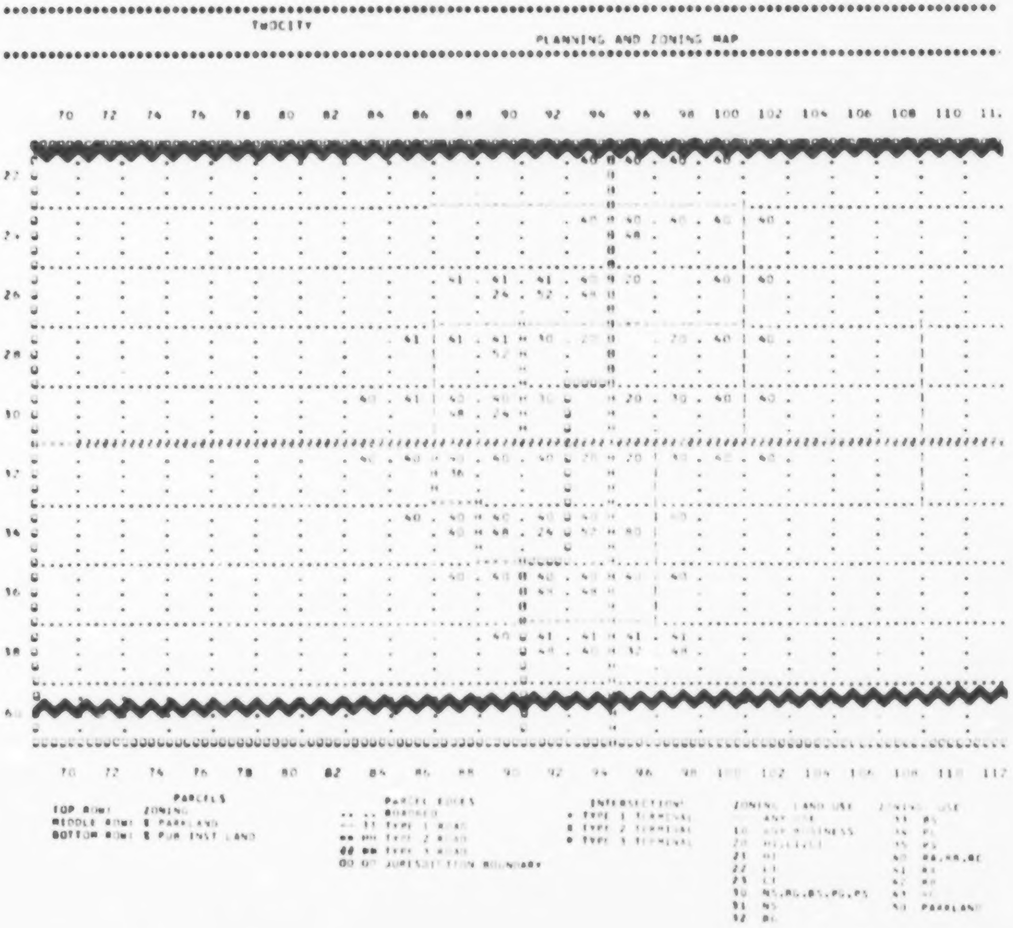
   NEW CASH BALANCE               5998000.
```

Planning and zoning map

This map shows the zoning that is in effect on each parcel of land for which the local jurisdiction has designated a zoning code. New land uses must conform to the zoning classifications. Existing land uses are not forced to change as the result of new zoning classifications that are inconsistent, however, under such conditions they cannot expand from their present constructed level. Parcels that have no zoning do not have any construction limits placed upon them. The land uses allowed under each zoning classification are shown in the Economic Master Table, in the Planning and Zoning Master Table, and on the map legend.

The percent of each parcel devoted to parkland and public institutional land is also shown on this map. Parkland is operated by the Planning and Zoning Department and serves the community in the form of football and baseball fields, picnic areas, hiking trails, and wooded land. Public institutional land contains costly public recreation facilities such as museums, art galleries, libraries, and sports arenas.

This map also shows the road network, terminals and jurisdictional boundaries.


TWOCITY
PLANNING AND ZONING MAP
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112
22 24 26 28 30 32 34 36 38 40
PARCELS
TOP ROW: ZONING
MIDDLE ROW: % PARKLAND
BOTTOM ROW: % PUB INST LAND
PARCEL EDGES
BORDERED
TYPE 1 ROAD
TYPE 2 ROAD
TYPE 3 ROAD
JURISDICTION BOUNDARY
INTERSECTIONS
TYPE 1 TERMINAL
TYPE 2 TERMINAL
TYPE 3 TERMINAL
ZONING LAND USE
ANY USE
10 ANY BUSINESS
20 HI,LI,CI
21 HI
22 LI
23 CI
30 RS,RG,BS,PG,PS
31 RS
32 RG
ZONING USE
33 BS
34 PG
35 PS
40 RA,RB,RC
41 RA
42 RB
43 RC
50 PARKLAND

Parkland usage map

This map shows the location and amount of land devoted to parks. Each parcel containing parkland has a number that indicates the percent of the parcel in parks. A park is all the parkland on a single parcel regardless of the percent of the parcel devoted to park use. Parkland from two parcels may not be combined into a single "park."

The local population using each park and an index value of parkland use are the other pieces of information on each park parcel.

The number of people living on a residence parcel is a measure of the demand for parkland by that parcel. This demand is met by parks within a 5-by-5 grid centered on that residence parcel. Each park within the grid is assigned a share of the residents on the residence parcel that is proportional to the size of each park relative to the total parkland within the grid.

Once all the residence demand has been allocated to parks (residences that have no parks within their 5-by-5 grid are not allocated to parks) the park use index is calculated by dividing the people served by 250 times the normalized percent of the parcel in parkland. The normalized percent of the land in parkland is derived by adding the percent in parkland and two times the percent of the land in public institutional use.

The park use index affects personal dissatisfaction in such a way that poor parks (those with use indices between 100 and 200) tend to diminish the positive effect that units of time spent in recreation has on the personal dissatisfaction index. The park index used by a residence parcel in determining the effect of park service on dissatisfaction is the park with the highest use index within the 5-by-5 grid area. A residence with no park to serve it is assumed to be served by a park with a use index of 200.

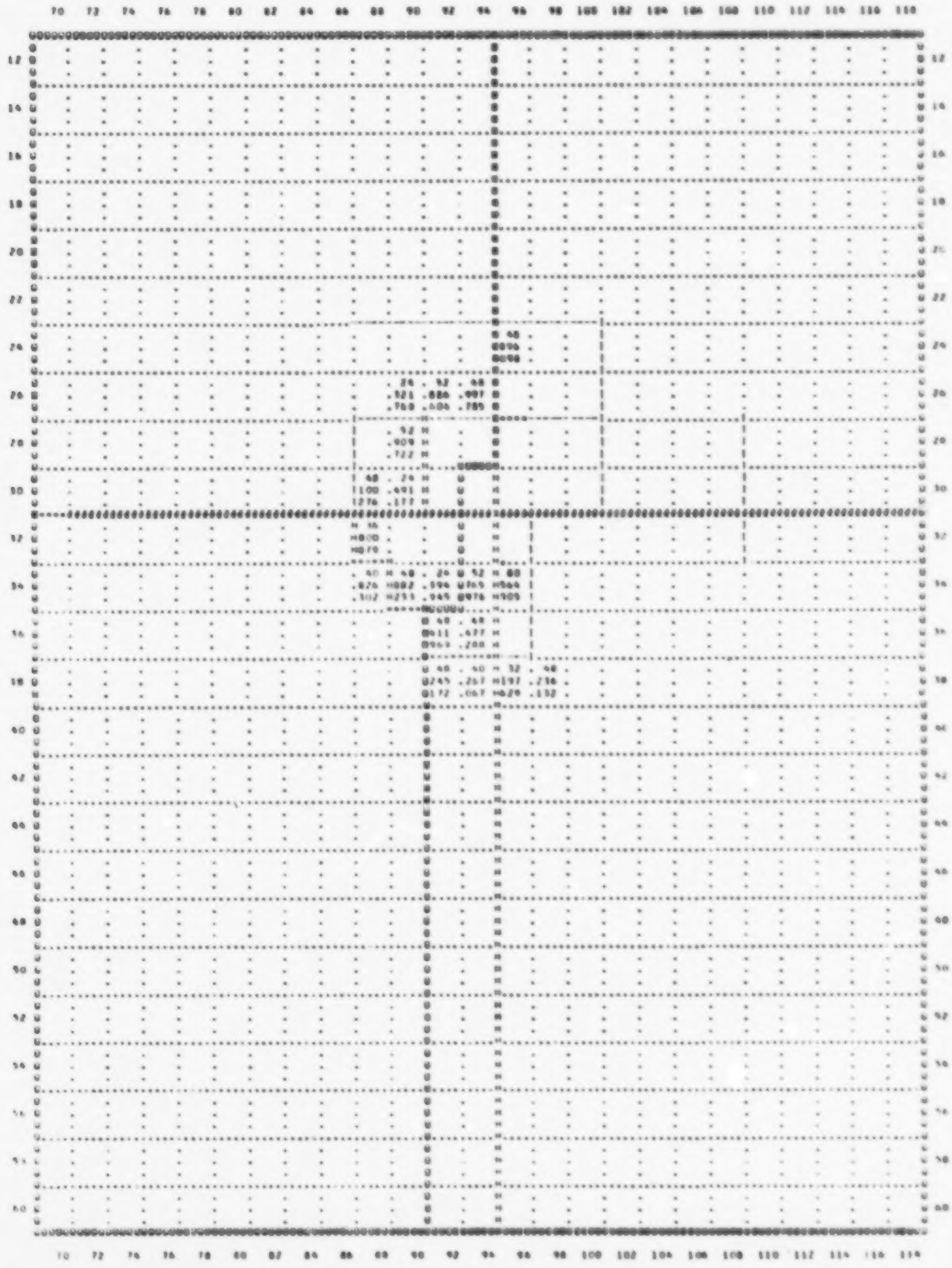
When a residence is served by a park with a park use index of 100 or less, the number of units of leisure time allocated by social classes on that parcel (TR = time in recreation) are subtracted from the personal dissatisfaction index. If the park index is greater than 100, the number of units subtracted from the personal dissatisfaction index is equal to the Park Use Index minus 100 (and expressed as a percent) times TR. Thus, if the Park Use Index is the worst possible (200) the effect of local park servece on the personal dissatisfaction index is zero. Therefore, park service quality has only a one-sided effect on personal dissatisfaction (it may subtract from personal dissatisfaction but never add to it).

This map also shows the road network, terminals, and jurisdictional boundaries.

TWOCITY

PARKLAND USAGE MAP

ROUND 1



PARCELS
TOP ROW: % PARKLND & PUB INST LAND
MIDDLE ROW: POPULATION SERVED (100'S)
BOTTOM ROW: PARK USE INDEX

PARCEL EDGES
.. .. ROADBED
-- II TYPE 1 ROAD
== HH TYPE 2 ROAD
@@ WW TYPE 3 ROAD
OO OO JURISDICTION BOUNDARY

INTERSECTIONS
+ TYPE 1 TERMINAL
X TYPE 2 TERMINAL
O TYPE 3 TERMINAL

Summary of Planning and Zoning Decisions

The department can make four types of decisions:

- Transfer cash (to other decision-makers)
- Change zoning
- Buy or sell land
- Create or demolish public institutional land uses

The department can make as many of each of these decisions as it wishes. The department can also choose to make no decisions. If no decisions are made, no cash or land is transferred, parks and public institutional land remain the same as in previous round, and previous zoning policy remains in effect.

Input Format

Planning and zoning decision-makers use a standardized input form when making decisions that must be processed by the computer. The standard message format is:

$CODE = DM/a, b, c, d, . . .

$CODE stands for the type of decision code. The PZ Department has the option to make decisions that use the following decision codes:

$ZONE (zoning, public institutional land)
$CASH (transfer cash)
$LT (land transfer)

"*=DM*" is the decision-maker, which for the PZ Department is *PZ1*, *PZ2*, or *PZ3*, depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the PZ decision-maker code even if there is only one active jurisdiction.

The columns "*a*", "*b*", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (10000).

RIVER
BASIN
MODEL

Decision Code		Decision-Maker		a	b	c	d	e	f	g	h	i	j	k
$_____	/	=_____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$_____	/	=_____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____

Planning and Zoning Department   Input Explanation Form

Type of decision	Code	Decision-maker	a	b	c	d	e
Transfer cash	SCASH	PZ1, PZ2, or PZ3	L	recipient (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	CAP	if recipient is: economic, PVT; social, H, M, or L; government, CAPital or CURrent account
Change zoning	SCVPT	PZ1, PZ2, or PZ3	[illegible]	location	new zoning code		
Acquire or transfer land	PU	PZ1, PZ2, or PZ3	location	price (in $1,000's)	seller (economic decision-maker or department and jurisdiction or OU)	percent of parcel (0 if all)	
Create or demolish public institutional land use	SCVPT	PZ1, PZ2, or PZ3	PI or RPI	location	percent of parcel to be added to or removed from public institutional uses		

NOTE: If SOCIAL RECIPIENT put 0 in column "f" and residential location in column "g".

Sample Decisions

Transfer cash: The Planning and Zoning Department in Jurisdiction 1 transfers $10,000 to the private account of Economic Team E, $1.2 million to the capital account of the Highway Department in its jurisdiction, and $50,000 to the capital account of the Planning and Zoning Department in Jurisdiction 3. It also made a cash transfer of $5000 to the low-income population units on parcel 11040 controlled by AA.

```
Decision    Decision-    a       b        c         d       e       f      g
  Code        Maker

$ CASH  / = PZ1 /  C  ,  E   ,  10000  ,  CAP ,  PVT ,  ____ ,  ____
$ CASH  / = PZ1 /  C  ,  HY1 , 1200000 ,  CAP ,  CAP ,  ____ ,  ____
$ CASH  / = PZ1 /  C  ,  PZ3 ,  50000  ,  CAP ,  CAP ,  ____ ,  ____
$ CASH  / = PZ1 /  C  ,  AA  ,  5000   ,  CAP ,  L   ,  0    ,  11040
```

Change zoning: The parcels 11012, 11212, 11412, 11014, 11214, and 11414 are given the zoning classification of 21 by the Planning and Zoning Department in Jurisdiction 2. Parcel 10238 is zoned 41 by Jurisdiction 1.

```
$ CVPT / = PZ2 /  Z , (11012>
                       11414) ,  21 ,  ____ ,
$ CVPT / = PZ1 /  Z ,  10238  ,  41 ,  ____ ,
```

Note that the block input procedure was used for the rectangular area being assigned the zoning code of 21. This is done by specifying the upper left-hand parcel and the lower right-hand parcel separated by a "greater than" sign (>).

Acquire or transfer land ownership: The Planning and Zoning Department in Jurisdiction 2 purchases 12 percent of parcel 10022 from Economic Team F for $56,000, bids $3,000,000 on all of parcel 9430 from the outside system, and transfers at no cost 6 percent of parcel 9246 to the School Department in its jurisdiction. (Note that the recipient of the land transfer is listed as the decision-maker.)

$ PU / = PZ2 / 10022, 56 , F , 12 , ____,
$ PU / = PZ2 / 9430, 3000 , 0U , ____, ____,
$ PU / = SC2 / 9246, 0 , PZ2, 6 , ____,

Create or demolish public institutional land: The Planning and Zoning Department in Jurisdiction 1 converts 20 percent of the land it owns on parcel 9430 to public institutional land uses (libraries, museums, zoos, etc.) and eliminates the public institutional land uses on 6 percent of parcel 10040.

$ CVPT / = PZ1 / PI , 9430, 20 , ____,
$ CVPT / = PZ1 / RPI , 10040, 6 , ____,

MASTER SHEETS FOR THE PLANNING AND ZONING DEPARTMENT

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	(Maximum Possible Levels)	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees PH	PM	PL	Terminal Units	MS Drain (MS Capacity Units)
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

Zoning Master Table

	Allowable Uses										
Code	**HI**	**LI**	**NS**	**BG**	**BS**	**PG**	**PS**	**RA**	**RB**	**RC**	**Park Land**
--	X	X	X	X	X	X	X	X	X	X	
00	X	X	X	X	X	X	X	X	X	X	
10	X	X	X	X	X	X	X				
20	X	X									
21	X										
22		X									
30			X	X	X	X	X				
31			X								
32				X							
33					X						
34						X					
35							X				
40								X	X	X	
41								X			
42									X		
43										X	
50											X

HI includes FL, SG, MP, MF, NL, EL, TE
LI includes FO, TA, PA, CR

PARKS MASTER TABLE

Demand for Recreational Space

One PH, PM, or PL is equal to 500 units of recreational demand.

Supply of Recreational Space

One percent of a land parcel devoted to parkland provides 250 units of recreation supply.

One percent of a land parcel devoted to public institutional land provides 500 units of recreation supply and costs $250,000 to develop.

Park Use Index (for a parcel with either or both types of parks) $= \frac{\text{units of recreation demand}}{\text{units of recreation supply}}$

Municipal services department

The local Municipal Services Department is given control of a number of resources and allocates these resources in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials and the local citizenry and business community.

The Municipal Services Department provides municipal services (police, fire, and health services) to population units and economic activities. The department receives appropriations from the chairman of the local jurisdiction. It may also float bonds for capital projects with approval from the social sector through a referendum.

The department makes capital expenditures when expanding its plant and facilities. Each new level of plant requires a specified amount of land (which must be acquired) and costs a specified dollar amount (see Master Tables, page **195**). Current expenditures must be made each round to pay salaries, purchase needed goods and services, pay off bonds, and cover welfare payment (if local unemployment exists and local welfare is paid).

Each MS plant has an associated municipal services district that is delineated by the department. All population units and business activities receive their needed municipal services from the plant serving the district within which they reside. The supply of municipal services for a district is dependent upon the level of the MS plant, its value ratio, and the number of PI's hired from the low and middle class. The demand for municipal services in a district is dependent upon the number and type of population units and business activities located within the municipal services district.

An index of the quality of municipal services within an MS district is derived from the ratio of the MS units demanded to the MS units supplied. This ratio is multiplied times 100 to arrive at an MS Use Index. As the Use Index rises above 100, the quality of service declines. This impacts on population units by causing their value ratio to decline at a faster than normal rate. An MS Use Index of more than 100 represents poor police protection, poor fire protection and poor health facilities.

The Municipal Services Department makes service decisions that affect the quality of life in the neighborhoods they serve and that affect the cost of doing business by manufacturing, commercial, and residential owners.

Municipal Services Department output

This report information is divided into five sections:

MS characteristics -- supply, demand and use index for each MS plant and totals for the jurisdiction.

Contracts -- contractural agreements to purchase business goods and services from specific suppliers

Undeveloped land -- location and amount of undeveloped land owned by the department

Outstanding bonds -- information on bonds still requiring annual payments

New construction -- information on the location, costs, and operating characteristics of new MS facilities.

Boycotts -- information on social classes boycotting MS jobs

MS Characteristics

The first column gives the numerical identification of the MS facility. Each facility in the represented area is given a unique identification number that is used on the computer maps. The second column gives the parcel location of MS facility. The third column provides the development level of the MS facility. These facilities may be built or upgraded to one of three levels.

```
*****************************************************************************************************
                                        FACILITY
                          MUNICIPAL SERVICES DEPARTMENT REPORT                          JURISDICTION
*****************************************************************************************************
                          MAINTENANCE     VALUE    EFFECTIVE CAPACITY                  EMPLOYMENT     M.S. USE
NO. LOCATION    LEVEL       LEVEL         RATIO       OF SERVICE          LOADING    LOW   MIDDLE       INDEX
-----------------------------------------------------------------------------------------------------

 2   [illegible]  1          [illegible]  [illegible]    1493              1925      6      6            129
 3   99-26      1          [illegible]  [illegible]    1493              1040      6      6             70

TOTALS                                                 2986              2965     12     12            109
 EMPLOYEE SHORTAGE LOW        [illegible]   MIDDLE    [illegible]
 SALARY OFFERED LOW  [illegible]   MIDDLE    [illegible]

AVERAGE PAYMENT PER UNEMPLOYED WORKER IS  [illegible]


C O N T R A C T S

----------------
                                 PERCENTAGE  OF   COST PER       CAPACITY        TOTAL
TYPE    OWNER    LOCATION     TOTAL PURCHASES        UNIT       UNITS USED       COST

-----------------------------------------------------------------------------------------------------

 [illegible]  [illegible]  [illegible]   100          100000          52          5200000
 [illegible]  [illegible]  [illegible]   100          100000          25          2500000

                                                                               7700000


UNSERVICED LAND
----------------
         LOCATION  AMOUNT      LOCATION  AMOUNT       LOCATION  AMOUNT
         --------  ------      --------  ------       --------  ------
          99-33    [illegible]     99-26    [illegible]       106-29     12


                                OUTSTANDING BONDS
                                -----------------


      TYPE             ORIGINAL      REMAINING      INTEREST          ANNUAL
                       PRINCIPAL       TERM           RATE            PAYMENT
      ----             ---------     ---------      --------          -------

     CAPITAL           [illegible]        2             [illegible]          312919.
     CURRENT           [illegible]        2             [illegible]          7232570.
```

The fourth column gives the maintenance level for the MS facilities. The department may change the maintenance level for any MS facility. The maintenance level is the lowest level to which the value ratio will be allowed to decline before maintenance expenditures are incurred.

The fifth column is the value ratio for each MS facility. The value ratio is a measure of the value and effectiveness of the plant and equipment in relation to "brand new" plant and equipment. A value ratio of 80 means that the effective capacity of a MS facility is reduced to 80 percent of what it would be if the value ratio were 100.

The sixth column is the effective capacity of service or the MS supply provided by each MS facility. This number is derived by multiplying the capacity that would be supplied as determined by the MS level and employment mix times the value ratio expressed as a percent.

The seventh column is the MS loading or MS demand generated by the population units and business activities located within the MS district boundaries. The MS units demanded by each type of activity is shown in the MS Master Table (page 194).

Columns eight and nine show the employment mix requested in terms of population units. The final column shows the MS Use Index. It is the ratio of loading (demand) to effective capacity (supply) multiplied times 100.

The salaries offered per worker to PL and PM employees are listed below the table along with the designated welfare payment per unemployed worker. If the MS Department did not hire all the population units it requested, the following message is printed:

"EMPLOYMENT SHORTAGE LOW 5; MIDDLE 0"

This would indicate that 5 PL's were not hired.

Contracts

The MS Department purchases goods and services each round as part of the costs of operating and maintaining their MS facilities. These purchases are made from BG and BS establishments in the local system if contracts to do so are submitted to the computer. If no contracts to purchase locally supplied goods and services are made, then all needed purchases are made from the outside system.

The contract table shows the type of goods or services in column one. In the second column, the owner of the establishment supplying the goods or services is indicated. The third column shows the parcel location of the supplier if it is a supplier within the local system.

The fourth column shows the percent of total purchases made from BG and BS suppliers. The fifth column shows the cost per BG and BS unit being charged by the supplier. (The Outside prices are fixed.) The sixth column shows the number of BG and BS units purchased and the last column shows the total cost. This cost is derived by multiplying the cost per unit times the number of units purchased.

Municipal Services Department finances

This report summarizes the department's financial transactions for the previous year. See the Introduction to the Government Sector for detail on the standard governmental budgetary procedure.

```
*****************************************************************************
                    JURISDICTION 2         TAXCITY
                          MUNICIPAL SERVICES DEPARTMENT FINANCES
*****************************************************************************
```

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```
                        FINANCIAL ACCOUNTING

      CAPITAL                                      CURRENT
PREVIOUS CASH BALANCE              1.      PREVIOUS CASH BALANCE        47531.

REVENUES                                   REVENUES
    APPROPRIATIONS                 0.        APPROPRIATIONS          12000000.
    BONDING                        0.        BONDING                 13700000.
    MISC. INCOME                   0.        MISC. INCOME                  0.
                                             FED/STATE AID            5810000.


                             -------                                 -------
TOTAL                              0.      TOTAL                     31510000.


EXPENDITURES                               EXPENDITURES
    CONSTRUCTION                   0.        WELFARE PAYMENTS        10432000.
    LAND PURCHASE                  0.        GOODS + SERVICES         7700000.
    MISCELLANEOUS                  0.        MISCELLANEOUS                 1.
                                             SALARIES                13104000.
                                             BOND PAYMENTS             312919.


                             -------                                 -------
TOTAL                              0.      TOTAL                     31548919.
                                                                            .

NEW CASH BALANCE                   1.      NEW CASH BALANCE              8612.
```

Undeveloped land

This table shows the parcel location for undeveloped land owned by the MS Department. It also shows the percent of the parcel owned by the department. The percent of a parcel required for a level one MS facility is shown in the MS Master Table (page **184**).

Outstanding bonds

This table shows the type (capital or current) of bond, the original principal, the number of rounds remaining to pay off the bond (all bonds start as 25 or 2 year bonds), the rate of interest being charged on the principal (determined by the state of the national bond market in the year the bond was floated), and the annual payment that must be made on the debt. Bond payments on a bond floated in round T begin in round T+1. Thus a current bond incurred in Round 2 will start being paid off in Round 3.

New construction

The Construction Table shows projects that were completed at the beginning of the round and therefore were in operation for the entire round. "Outside" indicates that an outside construction firm performed the construction. The site location is the parcel on which the MS facility was constructed. The status will always appear as "Completed".

Old level is the previous development level for the MS facility. A zero indicates that no MS facility previously existed on that parcel. The new level is the present development level for the MS facility after the construction. The price of construction is indicated along with the department-specified maintenance level (this applies to the entire structure) and the specified employment mix (this applies to the new total level not only to the newly constructed increment).

Boycotts

The Boycott Table shows three bits of information on the boycotting population units (team controlling, income class, and function which for MS boycotts will always be work). Three bits of information are formatted for the boycotted employer. When the MS Department is the employer being boycotted, "MS" and the jurisdiction number appear under the third column heading entitled "owner".

Municipal services map

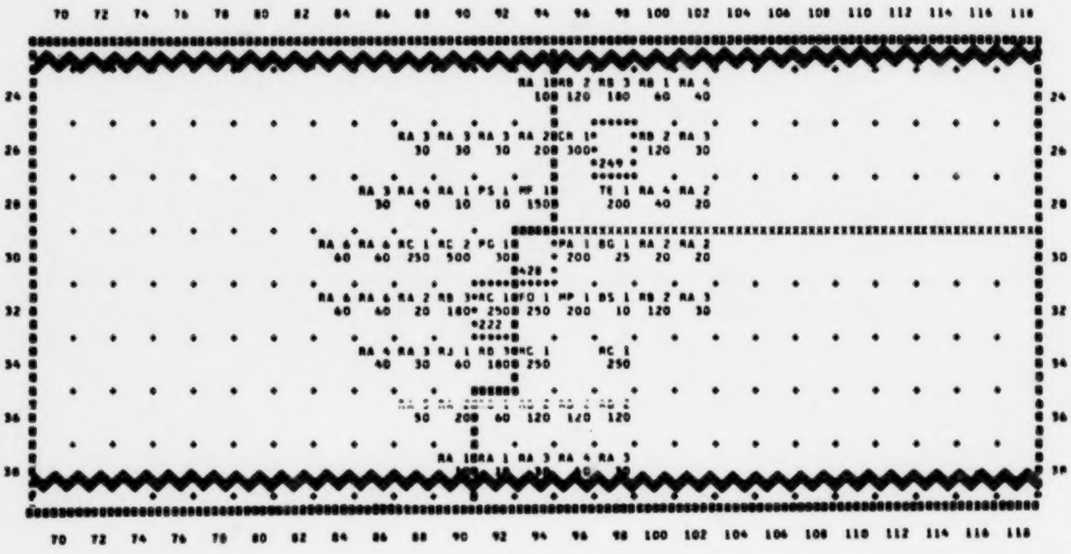
This map designates the jurisdictional boundaries (000) and the district boundaries (xxx) for all municipal service districts within each jurisdiction. Municipal service districts are groups of contiguous parcels that are within the service area of a municipal service (MS) plant. There may be parcels of land that are not contained within an MS district.

The information contained on a land parcel shows the private land use and constructed level and the number of MS units required by this private land use. The MS use index is shown on those parcels on which a MS plant is located. The parcel locations of MS plants are also indicated by surrounding asterisks (***).

Private land uses require the number of MS units indicated in the MS Master Table (see page **194**). Each land use receives the number of units of service it requires, but the quality of the MS service is based upon the ratio of units demanded within a district to the units that are available to the MS plant, given its level, value ratio, and employment mix. This ratio is called the *MS Use Index*, and as it rises above 100 the quality of service declines.

The *MS Use Index* affects the neighborhood index (neighborhood dissatisfaction) which in turn affects migration and housing selection; the *Use Index* also affects the rate at which private developments decline in value each round. To improve the *Use Index*, the MS Department may make several decisions: change district boundaries, upgrade maintenance levels thus improving the *Value Ratio*, change the employment mix, enlarge the present facility, or build a new facility.

TWOCITY
MUNICIPAL SERVICE MAP
ROUND 1



PARCELS
TOP ROW: LAND USE AND LEVEL
MIDDLE ROW: MS UNITS DRAINED
BOTTOM ROW: MS USE INDEX
(IF MS ON PARCEL)

PARCEL EDGES
XX DISTRICT BOUNDARY
OO JURISDICTION BOUNDARY
BB BOTH
** MS ON PARCEL

Summary of decisions: Municipal Services Department

The three categories of decisions made by the MS Department are those that are jurisdiction-wide in scope, those that pertain to individual MS plants and districts, and those that are capital land and construction decisions. The following table shows the eight types of decisions as they relate to these three categories.

Jurisdiction-wide:

- Change salary levels
- Award BG and BS contracts
- Transfer cash

Individual MS plants:

- Change district boundaries
- Change maintenance level
- Change employment requests

Capital:

- Acquire and sell land
- Construct or demolish MS plants

The MS Department does not need to make any decisions if it does not wish to do so. If no decisions are made, it is assumed that salaries, contracts, district boundaries, maintenance levels, and employment requests remain at their present values. If no decisions are made, there will be no cash transfers, land transfers, constructions, or demolitions.

The MS Department must be aware of the local system constraints on its decision-making. Capital expenditures may not be made unless there are sufficient funds in the capital account. New appropriations from the Chairman may increase the amount of these capital funds.

Input format

Municipal Services decision-makers use a standardized input form when making decisions that must be processed by the computer. The standard message format is:

[illegible], [illegible], [illegible], [illegible], ...

[illegible] stands for the type of decision code. The MS Department has the option to make decisions that use the following decision codes:

[illegible] (salaries)
[illegible] (contracts, maintenance, employment)
[illegible] (transfer cash)
[illegible] (redistrict)
[illegible] (land transfer)
[illegible] (construct or demolish)

"[illegible]" is the decision-maker, which for the MS Department is [illegible], [illegible], or [illegible] depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the MS decision-maker code, even if there is only one active jurisdiction.

The columns "[illegible]", "[illegible]", and so forth, are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER
BASIN
MODEL

Decision Code		Decision-Maker		a	b	c	d	e	f	g	h	i	j	k
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____
$____	/	=____	/	____,	____,	____,	____,	____,	____,	____,	____,	____,	____,	____

Municipal Services Department: Input Explanation Form

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f
Jurisdiction-wide								
Change Salaries	SOTHER	MS1, MS2, or MS3	S	new salary to low-income worker (in $100's)	new salary to middle-income worker (in $100's)			
Award BG or BS contracts	SCVPT	MS1, MS2, or MS3	C	location of BG or BS establishment	percent of total BG or BS purchase to be bought there	new priority	displaced priority	owner
Transfer cash	SCASH	MS1, MS2 or MS3	C	receiver (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if recipient is: economic, PVT; social, H, M, or L; government, CAPital or CURrent account	
	NOTE:	IF SOCIAL RECIPIENT put 0 in column "f" and location in column "g".						
Individual MS plants								
Change district boundaries	SREDIST	MS1, MS2, or MS3	location of MS plant	list of new parcels in parentheses[a]				
Change maintenance level	SCVPT	MS1, MS2, or MS3	M	location of plant	new maintenance level			
Change employment	SCVPT	MS1, MS2, or MS3	E	location of plant	new number of PL's working there	new number of PM's working there		

[a] Rectangular areas comprised of parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by "*". Example: SREDIST/=MS1/9230, (9232 * 10040)

Municipal Services Department Input Explanation Form

Type of Decision	Code	Decision-Maker	a	b	c	d	e	f	g
Capital									
Acquire land	$PU	MS1, MS2, or MS3	location	price (in $1000's)	seller (economic decision-maker or department and jurisdiction or OU)	percent of parcel (0 if all)			
Construct, upgrade, or demolish an MS plant	$OUBLD	MS1, MS2, or MS3	site	MS	old level (0 if new building)	new level (0 if demolition)	maintenance level	new number of PL's working there	new number of PM's working there

Sample decisions for the MS Department

(The input format is shown below each example. Note that the jurisdiction number must always be given even if only a single jurisdiction exists.)

Jurisdiction-wide decisions

Change salary levels: The MS Department in Jurisdiction 2 wishes to change its salaries for PI's to $2700. Note that no dollar signs need to be placed on the dollar amounts and that the old salary for the PM's must also be input. The decision is to change salaries, and if nothing had been placed in the column for PM salary, the computer would read the blanks as zeroes and the new PM salary would be put to the minimum amount.

```
   Decision  Decision-   a     b     c
     Code      Maker
$  OTHER / = MS1  /  S  , 27  , 51
```

Award BG or BS contracts: Case 1: The MS Department in Jurisdiction 3 wishes to make a BG contract so that all its purchases will be made from a single local supplier (BS at 9830) Presently, all the purchases are being made from the outside system.

```
$ CVPT / = MS3 / C , 9830 , 100
```

Case 2: The MS Department in Jurisdiction 1 wishes to split its BS purchases between two local suppliers in such a way that one gets 60 percent of the MS business (BS at 10012) and the other gets 40 percent (BS at 10636). Previously, a third BS establishment at 11040 had supplied all of the BS services for the MS Department. Its contract must be negated.

```
$ CVPT / = MS1 / C , 10012, 60
$ CVPT / = MS1 / C , 10636, 40
  OVPT / = MS1 / C , 11040, 0
```

A department in a jurisdiction may not have more than three contracts for BG or more than three contracts for BS purchases.

Transfer cash: Case 1: The MS Department in Jurisdiction 2 wishes to transfer $1,000,000 from its current account to its capital account.

$CASH / = MS2 / C, MS2, 1000000, CUR, CAP

Case 2: The same department wishes to transfer $525,000 to Economic Team B from its current account.

$CASH / = MS2 / C, B, 525000, CUR, PVT

Operational Decisions for Specific MS Plants

Change district boundaries: The decision to change the boundaries for one MS plant does not require that the boundaries for other MS plants be changed unless contiguity is involved. If the MS Department makes substantive error in any of its redistricting decisions in a round, all the redistricting decisions are rejected. The MS Department in Jurisdiction 1 decides to add a previously unserved parcel (9048) to the MS district served by the MS plant on parcel 9036. It also wants to add parcels 9840, 9842, 10040 and 10042. These four parcels form a "block input".

$REDIST / = MS1 / 9036, (9048, 9840 > 10042)

Change maintenance level: The MS Department in Jurisdiction 2 decides to raise the maintenance level for its MS plant at 7420 to 80, and to lower the maintenance level for its MS plant at 7630 to 85. Example shows multiple coding.

$CVPT / = MS2 / M, 7420, 80 / M, 7630, 85

Change equipment [illegible] The MS Department in Jurisdiction 2 decides to change the labor mix for the MS plant at 7420 to 3 PL and 4 PM and to change the mix at the second level plant at 7630 to 7 PL and 8 PM.

$CVPT / = MS2 / E, 7420, 3, 4

$CVPT = MS2 / E, 7630, 7, 8

Capital decisions:

Acquire or sell land: Case 1: The MS Department in Jurisdiction 1 purchases 12 percent of parcel 7842 from Economic Team B for $570,000.

$ PU / = MS1 / 7842, 570, B, 12

Case 2: The MS Department in Jurisdiction 2 attempts to purchase 24 percent of parcel 10032 from Outside System owners with an unsolicited bid of $1,500,000.

$ PU / = MS2 / 10032, 1500, OU, 24

Case 3: The MS Department in Jurisdiction 3 gives 12 percent of parcel 8436 to the Planning and Zoning Department in its jurisdiction. (Note that the receiver is designated as the decision-maker).

$ PU / = PZ3 / 8436, 0, MS3, 12

Construct an MS plant: Case 1: The MS Department in Jurisdiction 1 wishes to build an MS plant on parcel 8832, have a maintenance level of 90, and hire 3 PL's and 3 PM's to work there.

$ OUBLD / = MS1 / 8832, MS, 0, 1, 90, 3, 3

Case 2: The department also decides to upgrade the MS plant on parcel 10010 from a level 1 to a level 3 and make the new maintenance level for the entire facility be 85 and hire 12 PL and 15 PM.

$ OUBLD / = MS1 / 10010, MS, 1, 3, 85, 12, 15

Case 3: Because of the demolition of several major businesses within its boundaries, the MS plant at 8640 has been slated for a reduction in capacity by the MS Department in Jurisdiction 2. It is decided that the plant should be reduced from a level 2 to a level 1 and the maintenance reduced to 70 and employment cut to 3 PL and 2 PM.

$ OUBLD / = MS2 / 8640, MS, 2, 1, 70, 3, 2

MASTER TABLES FOR MUNICIPAL SERVICES DEPARTMENT

PLANNING MASTER TABLE

(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	(Maximum Possible Levels)	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees			Terminal Units	MS Drain (MS Capacity Units)
						PH	PM	PL		
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

MASTER SHEET FOR MUNICIPAL SERVICES DEPARTMENT

Level One Plant

General Characteristics

Typical Construction Cost	$30,000,000
Land Requirement	6%
Annual Depreciation Rate	3.3%

BG and BS Requirements

For 1% Renovation or Maintenance	
BG	2 units
BS	1 unit
For Normal Operation	
BG	7 units
BS	3 units

Design Capacity (MS units) as a Function of the Number and Class of Population Units Assigned to Work There

		PL						
			1	2	3	4	5	6
PM	0		140	230	380	500	680	730
	1	200	330	470	620	740	850	950
	2	400	550	700	860	970	1,080	1,180
	3	600	780	940	1,100*	1,220	1,320	1,420
	4	730	970	1,170	1,300	1,400	1,500	1,590
	5	950	1,150	1,300	1,480	1,580	1,670	1,750
	6	1,100	1,325	1,490	1,660	1,740	1,825	1,900

Effective capacity of an MS Plant:

Effective capacity = design capacity x value ratio/100.

MS Use Index - affects depreciation of economic land uses and social sector dissatisfaction.

$$\text{MS Use Index} = \frac{\text{Actual No. of MS Units Drained}}{\text{Effective Capacity of MS Plant.}} \times 100$$

MS Use Index above 100 means the plant is being overused and depreciation and dissatisfaction will be increased.

Federal-State Aid for Welfare Payments.

$2 Federal-State for each local dollar up to a maximum equivalent to $35 per resident of a jurisdiction.

OPERATION OF FEDERAL-STATE AID

Department	Basis			Limit on Number of Requests per Jurisdiction	Probability of Receipt
School					
Current Aid	$225/student			N.A.	Automatic (no request needed)
Capital Aid	Match dollar for dollar			3	60% (1st request) 40% (2nd request) 30% (3rd request)
		Matching			
Highways	Type of Road	Federal	Local		
Capital Aid	I	$1	$9	5 road segments	80%
	II	$1	$1		50%
	III	$2	$1		30%
Municipal Services					
Current Aid	Two Federal-State dollars for each local dollar up to maximum total paid of $35 per resident of the jurisdiction			N.A.	Automatic

Utility department

The Utility Department is given control of a number of resources within the local system and allocates these resources in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials and the local citizenry and business community.

The Utility Department is responsible for the provision of the utility and water and sewer services which economic activities require in order to operate. The department's utility operations are separate from its water and sewer operations but both are funded from the department's general budget.

Like the Bus and Rail departments, the Utility Department can operate as either a public or a private enterprise. Each utility plant has its own district, comprised of full parcels contiguous to the utility plant. A utility district is also a water district, which can contain one water intake treatment plant and one sewage treatment plant. When utility service is installed on a parcel, water and sewer services are also installed.

Utility plants, intake treatment plants, and outflow treatment plants are constructed in levels, each level having a fixed capacity of service. Outflow treatment plants are also constructed as certain types, each type having the ability to remove different amounts of each pollutant type. All of the plants require a fixed amount of land for each constructed level. When a level is demolished, the land becomes available for other Utility Department construction or sale to another owner.

The Department sets the price which any economic activity must pay per utility-unit consumed. Each activity consumes a different number of utility units, but the price per unit consumed is the same for every utility user. The Department also sets the water price per MG consumed, but the price set can vary by the type of economic activity, and, in the case of residences, by class. The quantity and quality of water in the local water system affects the costs of providing water service to the local system users.

Utility department output

The Utility Department output consists of a financial summary, a report on utility plants, treatment plants, water sampling stations, and miscellaneous other information of concern to the Department.

Utility department finances:

All capital and current revenues and expenditures are summarized on this output. Capital expenditures are made in direct response to player decisions; current expenditures are made in response to policies set by players. All capital revenues and the current revenues of subsidies, bonding, and miscellaneous income are obtained in the manner described in the introduction to the Government Sector (page **139**). The Utility Department has two additional sources of current income: income from utility users and income from water users. For the most part, the two types of users are identical. However, some types of basic industries use surface water directly and do not require municipal water although they do require utilities. Also, small residences (RA) **may** have private utilities (well water, septic tanks, etc.) and do not use municipally-provided utilities or water.

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```
                                  UTILITIES
                                  ---------

           CAPITAL                                   CURRENT
           -------                                   -------

PREVIOUS CASH BALANCE                   0.      PREVIOUS CASH BALANCE    7934755

REVENUES                                        REVENUES
     SUBSIDIES                          0.        SUBSIDIES                    0
     BONDING                     50000000.        BONDING                      0
     MISC. INCOME               100000000.        MISC. INCOME                 0
                                                  UTILITY USERS         26110000
                                                  WATER USERS            2431350

                                  -------                                 ------
TOTAL                           150000000.      TOTAL                   28541350


EXPENDITURES                                    EXPENDITURES
     UTILITY PLANT CONSTR.       30000000.        UTILITY OPERATION     25800000
     TREATMENT PLANT CONSTR.     54000000.        TREATMENT OPERATION    1242661
     MISCELLANEOUS                      0.        SAMPLING STATIONS       825000
     EXTENSION OF SERVICE         7000000.        MISCELLANEOUS                0

     LAND PURCHASE                   2000.        BOND PAYMENTS          1189055

                                  -------                                 ------
TOTAL                            91002000.      TOTAL                   29056716


NEW CASH BALANCE                 58998000.      NEW CASH BALANCE         7419389
```

The Department also sets the water price per MG consumed, but the price set can vary by the type of economic activity, and, in the case of residences, by class. Utility users always obtain the utility service which they need; the only variable is the price set by the Utility Department. However, the Utility Department might not always be able to provide sufficient water for all of its users' needs, the reasons for which are explained below. A water shortage is relevant to current revenues because water users pay the Department for only the water which they actually obtain from the municipal system.

Capital expenditures are separated into five types: utility plant construction, treatment plant construction, extension of service, land purchase, and miscellaneous. The expenditures under utility plant construction also include utility plant demolition costs. The cost to construct or demolish each level of a utility plant are given on the Master Table (page **228**). Treatment plant construction costs include the costs to construct and demolish levels of intake treatment plants and the costs to construct and demolish types and levels of effluent treatment plants. The costs for extension of utility service include extension of water and sewer service to those parcels receiving utilities for the first time. Once a parcel has utilities, it never needs more water and sewer service; if a parcel has any utility service of whatever level it has sufficient water and sewer service for any level of any economic activity. The land purchase expenditure category includes income from land sale. Both utility plants and treatment plants require land for construction. Miscellaneous capital expenditures are the total of all cash transfers made from the department's capital account.

There are five types of current expenditures: utility plant operation, treatment plant operation, sampling station operation, bond payments, and miscellaneous. The expenditure for utility plant operation is the total of the operating costs of all of the utility plants in the jurisdiction. Treatment plant operation is the total of the operating costs of all of the intake and outflow treatment plants in the jurisdiction. There is one fixed cost to operate each ambient (river quality) sampling station and another fixed cost to operate each point source (user effluent quality) sampling station. The total operating cost of all sampling stations in the jurisdiction appears as a single current expenditure. Payments on both current and capital bonds are made through the current account. Miscellaneous current expenditures are the total of all cash transfers made from the department's current account.

The new cash balances in both accounts remain in those accounts and are available for expenditure in the following round.

Utility department report

This report contains detail on each utility plant in the jurisdiction and detail of importance to the department as a whole (water and utilities) on undeveloped land and outstanding bonds. The detail on utility plants consists of a table on which each row is a utility plant. The first two columns contain the utility district code number and the coordinates of the parcel on which the utility plant is located. Next is the level of utility plant. Each level has a fixed capacity in terms of the number of utility units which it can provide.

```
*********************************************************************************************************
                                                     TWOCITY
                                                     UTILITY DEPARTMENT REPORT  JURISDICTION 1          ROUND  2
*********************************************************************************************************
                                              UNITS          UNITS        OPERATING       OPERATING
PLANT     LOCATION       LEVEL              INSTALLED        SERVED          COSTS         COST/UNIT           INCOME

---------------------------------------------------------------------------------------------------------

  1         94-24          3                  3300            2676        25946664.             9695.      26760000.

                                                             TOTALS        25946664.                        26760000.
CHARGE TO CUSTOMERS --     10000 PER UNIT


UNDEVELOPED LAND
----------------
          LOCATION  AMOUNT      LOCATION  AMOUNT
          --------  ------      --------  ------
            94-24      9          90-30      3


                                 OUTSTANDING BONDS
                                 -----------------


       TYPE            ORIGINAL     REMAINING    INTEREST         ANNUAL
                       PRINCIPAL      TERM         RATE           PAYMENT
       ----            ---------    ---------    ---------        -------

     CAPITAL           15000000.       3            4.1            970566.
     CAPITAL           40000000.      25            3.0           2297141.
```

The next two columns show the number of utility units installed on parcels served by the plant. This number is the maximum number which an activity located on each parcel can draw upon. The program rejects any construction which would require more utility units than are installed on the parcel. The number of units installed and attached to a plant are always greater than or equal to the number of units provided by the plant. The units are those actually being consumed. Units installed indicates potential consumption. However, a level of a plant has a maximum capacity in terms of units provided. That maximum cannot be exceeded.

There is an optimum number of units which a level of utility plant can produce. Below and above that number the operating cost per unit provided (equal to a unit of income) is greater than that optimal minimum cost per unit. Column six, total operating cost for the year, is less informative than column seven, the operating cost per unit provided.

The last column shows the total income which the district receives for providing utility service. An economic activity pays for only the number of utility units which it drains, regardless of the number installed on the parcel on which the activity is located.

The undeveloped land table shows the location and percent of parcel owned wherever the department owns undeveloped land. Utility plants, intake treatment plants, and outflow treatment plants require land. When a building is constructed, land is subtracted from the department's undeveloped land account.

Each outstanding bond is listed on the bond table, one row per bond. The first item is the type of bond, capital or current. A capital bond has a term of 25 years; a current bond has a term of 2 years. The original principal, remaining term, interest rate, and annual payment are given. The remaining term is the number of rounds after the current round in which the department must make the annual payment. The annual payment is calculated by the computer to pay off the bond in equal installments each year, and the payment is made automatically by the computer from the department's current account.

Utility Map

This map designates the jurisdictional boundaries (OOO) and the district boundaries (xxx) for all utility plants within each jurisdiction. Utility districts are groups of contiguous parcels that are within the service area of a utility plant. There may be parcels of land that are not contained within a utility district. Utility district boundaries are the same as those of water districts.

The information contained on a land parcel shows the number of utility units required by utility users, the number of utility units installed on the parcel, and the number of the utility district serving the parcel.

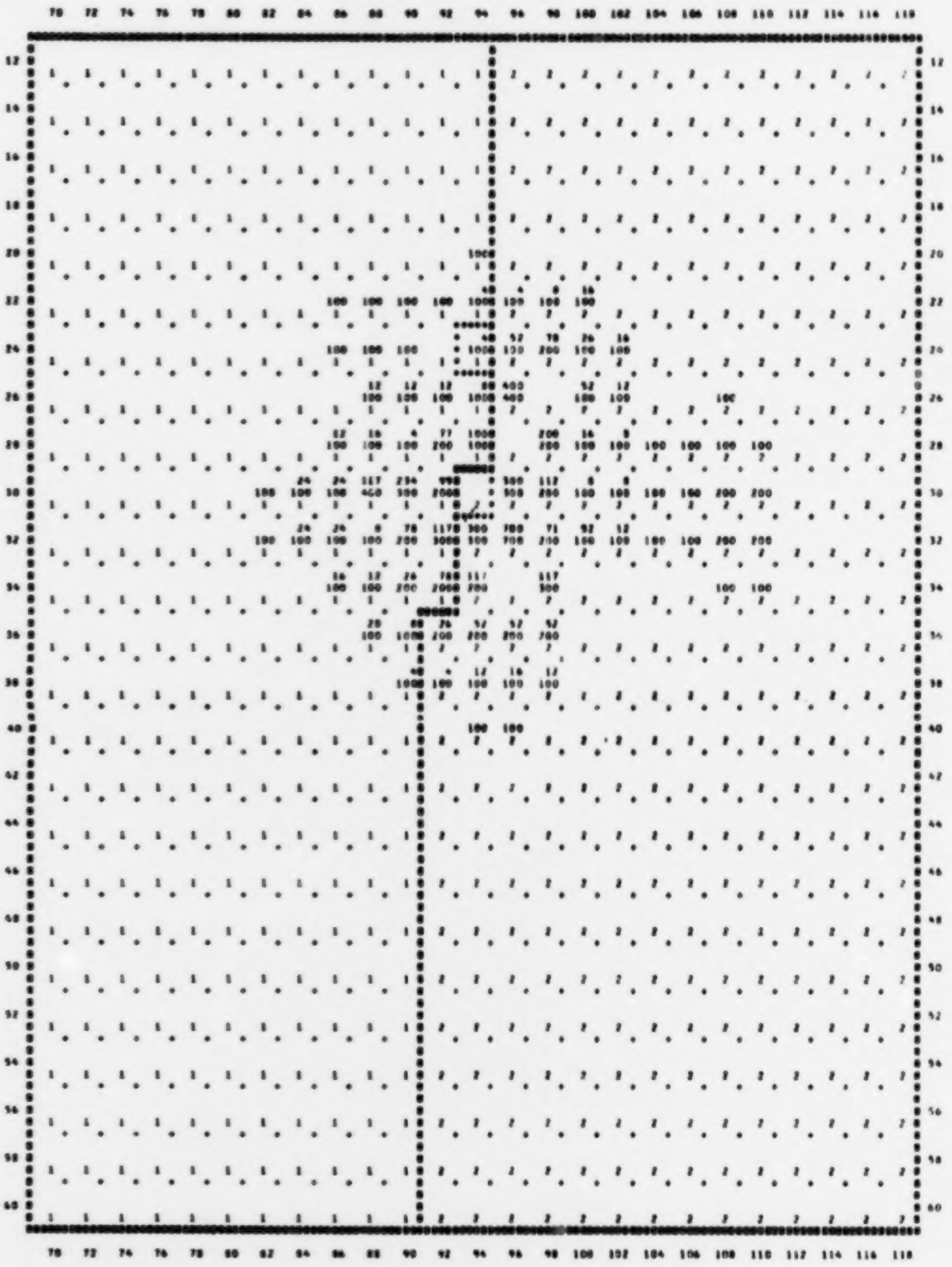
Utility plant locations are indicated on the Utility Map with asterisks surrounding the parcels on which the plants are located. Each utility district is identified with a unique utility number. The bottom piece of information on each parcel indicates the number of the utility plant serving that parcel.

The number of utility units consumed on a parcel is dependent upon the private land-use activity. The map key shows a number of utility units demanded by a "level one" of each of the private land-use activities.

The number of units installed on a parcel is a policy decision made by the Utility Department. The Utility Department provides one of nine levels of utility service to a parcel. Each level of utility service has a corresponding number of utility units that may be provided. Consult the Utility Master Table for the maximum number of utility units that may be provided for each level of utility service.

A parcel of land that is within a utility district may not be developed if the private development would require more units of utility service than could be provided by the present level of utility service provided to that parcel. Thus, the "Units installed" puts an upper limit on the "Units served" for all parcels within utility districts. District boundaries and the units installed can be changed by the Utility Department.

```
            TWOCITY
                                          UTILITY MAP                                          ROUND  1
```



```
        PARCELS                                 PARCEL EDGES                     UNITS REQUIRED    UNITS REQUIRED
TOP ROW:    UNITS SERVED                     XX DISTRICT BOUNDARY                 BASIC INDUSTRY    COMMERCIAL
MIDDLE ROW: UNITS INSTALLED                  OO JURISDICTION BOUNDARY               HI1  402         BG1  112
BOTTOM ROW: UTILITY CODE IF UT ON PARCEL     OO BOTH                                LI1  135         BS1   71
                                             ** UT ON PARCEL                        NS1   76         PG1   99
                                                                                  RESIDENCES         PS1   77
                                                                                    RA1    4        CONSTRUCTION
                                                                                    RB1   26         CI1  NONE
                                                                                    RC1  117
```

Water department reports:

Four types of detailed information are shown on this output: intake treatment plant status, outflow (effluent) treatment plant status, municipal sampling station reports, and the water prices which have been set by the department.

```
INTAKE TREATMENT PLANTS
-----------------------
                                    INTAKE   WATER      WATER                   TOTAL
                           INFLOW   WATER    NEEDED    OBTAINED   CAPACITY    TREATMENT    TREATMENT      INCOME
PLANT  LOCATION  LEVEL     POINT   QUALITY   (MGD)      (MGD)      (MGD)        COST       COST/MGD     FROM USERS
-----  --------  -----     ------  -------   ------    -------    --------   ---------    ---------    ----------

  2      9833      6        9830      1       15.10     15.10        60       $  26988     $  1787      $  2431350
```

The intake treatment plant table has one row per intake plant. Each intake treatment plant has the code number of the utility district in which it is located and which it serves. Both the plant code number and its coordinates are given here. An intake plant also has a level, which denotes its maximum capacity (in MGD) to treat water.

The water which is treated at an intake treatment plant may actually be obtained from surface water anywhere in the simulated region, although the water intake for a single utility district must all be from a single parcel having surface water. The coordinates of the parcel on which a district's intake point is located are in the fourth column. The fifth column shows the intake water quality. Intake water quality affects the cost which the department must pay in order to treat the water to drinking water quality. The worse the water, the greater the cost per MG to treat.

The total water requirement (in MGD) of all of the water users in the utility district is in the sixth column. The seventh column contains the total amount of water (in MGD) which the department was able to obtain from the surface water at its intake point. The amount obtained is never greater than the amount needed. There are three possible reasons that the amount obtained could be less than the amount needed: (1) the water quality on the parcel on which the intake point is located is 9; (2) the total amount attempted removed by surface water users (municipal intake points or surface water using basic industries) from the parcel on which the intake point is located is greater than the amount of water on the parcel; (3) the intake treatment plant has the capacity to process a volume less than the total amount needed by the district's water users. In the first case, no water users supplied by the municipal system receive municipal water; all purchase from the Outside. In the second and third cases each water user receives a share of municipally-supplied water proportional to its needs. If both the second and third cases apply, the lesser amount is removed from the surface water and treated.

The seventh item, total treatment cost, is the plant's operating cost for the year, based on the total water users' annual requirements (in MG), the proportion of their daily needs (MGD) which the district provided, and the quality of the intake water. The proportion is multiplied by the total annual requirement and then multiplied by the cost per MG to treat water at the intake quality. For example, suppose that a district contained only a BGI and a TEI, had a level I intake plant, quality 4 intake water, and no shortage of water at the intake point. Assume that the Master Tables showed that: a BGI requires .17 MGD and 41 MG annually; a TEI requires 8 MGD and 2080 MG annually; a level I intake plant can treat 3 MGD; and the cost per MG to treat quality 4 water is $100. Then the total amount needed (MGD) would be 8.17. The amount obtained would be 3.00, and the capacity would be 3.00. The total treatment cost would be:

$$3.00/8.17 \times (41 + 2080) \times \$100 = \$77882$$

The treatment cost per MGD is the total treatment cost divided by the MGD obtained.

The last item on the table, income from users, is the total income from the district's sale of water. Water users pay the department only for that portion of their water needs which is provided locally. They pay the local price per MG for the number of MG's obtained from the district.

```
OUTFLOW TREATMENT PLANTS
------------------------
                       TYPE             AMOUNT OF    PLANT        TOTAL
                        AND    OUTFLOW  EFFLUENT    CAPACITY    TREATMENT    TREATMENT
    PLANT  LOCATION   LEVEL     POINT     (MGD)      (MGD)        COST       COST/MGD
    -----  --------   -----   -------  ---------   --------    ---------    ---------

      2      9632      TT6      9632     15.10         60      $ 1215673    $ 80508
```

Whereas a water user may obtain some of its water from Outside, all of its effluent is dumped into the municipal sewer system (for municipal water users only). Thus a district receives revenue only for water provided but receives the total amount of effluent generated in the district. On the outflow treatment plant table, each outflow plant has a row. The first two columns contain the code number of the utility district in which the plant is located and which it serves, and the coordinates of the outflow plant.

The third column is the treatment type and level. Level denotes the maximum amount of effluent which the plant can treat. Type denotes the amount of each pollutant removed from the effluent which the plant treats. The four types of plants, in increasing order of pollution removal, are: chlorination (CL), primary treatment (PT), secondary treatment (ST), and tertiary treatment (TT).

The sewage generated by a district may be dumped into surface water anywhere in the simulated region, although all of the outflow for a single district must be on a single surface water parcel. The coordinates of the parcel on which the district's outflow point is located are given in the fourth column.

The fifth column contains the amount of effluent (in MGD) generated by all of the water users in the district. That amount is equal to the amount of water needed shown on the intake treatment plant table. The plant capacity (in MGD) is in the next column and is the maximum amount which can be treated. If the amount of effluent is greater than the plant capacity, the difference between the amount of effluent and the amount treated is dumped untreated at the outflow point. The amount treated has a proportion of pollution removed according to the treatment type.

The total treatment cost, the treatment plant's operating cost for the year, is based on the total water users' annual requirements (in MG), the proportion of their effluent which the plant treated, and the treatment cost per MG for the treatment type and level. The proportion is multiplied by the total annual requirement and then by the treatment cost per MG for the treatment type. For example, suppose that the same district in the previous example had ST2 effluent treatment, and that the Master Tables showed that a level 2 has a capacity of 8 MGD and that the treatment cost per MG at ST2 is $190. The total treatment cost would be:

$$8.00/8.17 \times (41 + 2080) \times \$190 = \$394{,}605$$

The last column, treatment cost per MGD, is the total treatment cost divided by the amount treated (in MGD).

```
MUNICIPAL SAMPLING STATION REPORTS
----------------------------------

                                                                BACTERIALS   TEMPERATURE   OIL AND    HIGH      AMOUNT OF
                       BOD       CHLORIDES   NUTRIENTS      (PARTS       DEVIATION     FLOATING   LEVEL       WATER
DIST   LOCATION    (LBS/MG)    (LBS/MG)    (LBS/MG)       PER MG)      (DEGREES)     SOLIDS     WASTES      (MGD)
----   --------    --------    ---------   ---------    ----------   -----------   --------   ------    ---------

   2     9432        10.97        0.39       24.64          0.0           0.0          NO        NO         19.10
```

The department can set up sampling stations to monitor the concentration of each pollutant in the municipal effluent which it dumps into the surface water. Municipal sampling stations must be located on parcels where municipal systems have outflow points. The municipal sampling station report lists one row per sampling station. The first two columns contain the code number of the utility district which the outflow point serves and the coordinates of the outflow point. The next seven columns show the concentration of each pollutant in the effluent being dumped (after any treatment). Oil and floating solids and high-level wastes are either present or not; they are not measured in concentrations. Suppose that, in the example given above, the Master Table showed the effluent content of a BGI and a TEI to be:

	BOD (LBS/MG)	Chlorides (LBS/MG)	Nutrients (LBS/MG)	Coliform (parts/MG)	Temperature Deviation	Oil & Floating Solids	High-Level Wastes
BGI	200	0	0	10	0	No	No
TEI	500	180	100	30	0	No	No

Then the volume of pollution before treatment would be:

BOD: $200 \times .13 + 500 \times 8 = 4026$ Lbs.
Chlorides: $0 \times .13 + 180 \times 8 = 1440$ Lbs.
Nutrients: $0 \times .13 + 100 \times 8 = 800$ Lbs.
Coliform: $10 \times .13 + 30 \times 8 = 241.3$

The amount of pollution to be treated would be 8.00/8.17 of the amount in the effluent. Thus, the amount treated and untreated would be:

	Treated	Untreated
BOD	3945	81
Chlorides	1411	29
Nutrients	784	16
Coliform	236	5

Suppose that the Master Table showed that ST removed:

BOD	Chlorides	Nutrients	Coliform	Temperature	Oil & Floating Solids	High-Level Wastes
80%	60%	50%	99%	0%	100%	0%

Then the amount of pollution remaining in the treated effluent would be:

BOD: (100 - 80) x 3945 = 789
Chlorides: (100 - 60) x 1411 = 564
Nutrients: (100 - 50) x 784 = 392
Coliform: (100 - 99) x 236 = 2

The total amount of pollution dumped would be:

BOD: 789 + 81 = 870
Chlorides: 564 + 29 = 593
Nutrients: 392 + 16 = 408
Coliform: 2 + 5 = 7

The sampling station report would show those concentrations to be:

BOD: 106.49 LBS/MG (870/8.17)
Chlorides: 72.58 LBS/MG (593/8.17)
Nutrients: 49.94 LBS/MG (408/8.17)
Coliform: .86 PARTS/MG (7/8.17)

The last column in the table is the total volume of effluent dumped at the outflow point. Actually, the volume of effluent dumped is unimportant, since the amount of surface water on a parcel is constant. What does matter is the total amount of pollution dumped, not its concentration. Once in the surface water, the concentration of each pollutant depends on the volume of the surface water and the amount of each pollutant already in the surface water, not on the amount of effluent.

WATER PRICES

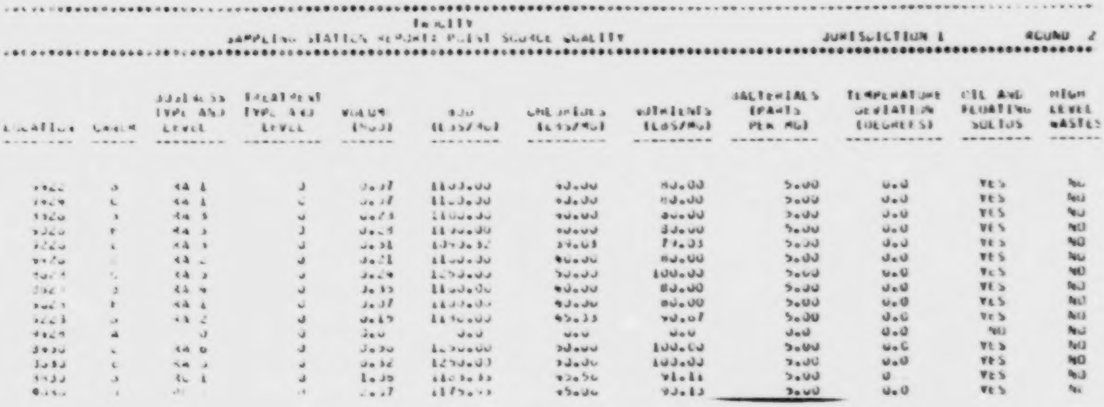
ACTIVITY		PRICE/MG
OUT	$	700
NS	$	450
CI	$	450
BG	$	450
BS	$	450

Water prices are the last section of the Water Department Report. The two-letter code of each activity and the price per MG are listed. The first activity, *OUT*, is the Outside price per MG which water users pay for any water which they cannot obtain locally. That price is the same for all jurisdictions and is not controlled by the department.

All of the other prices in the list are set by the department. Note that the department does not set prices for basic industries which use surface water, since those industries obtain and treat their own water. The department sets one price for each type of economic activity except residences. Residence prices are set by residence type and by class. The first letter of the two-letter code is the class and the second is the residence type. 'LB' would be low-income living in residence type RB. Water consumption by a PI varies by class and residence type. In general, high-income consume more water than low-income, and RA residents consume more water than RC residents. See the Master Tables (page **227**) for the exact amounts of water consumption.

Sampling station report: Point-source quality

The department can sample the effluent discharged by any economic activities in the jurisdiction at a fixed cost per sampling station. The concentration of a basic industry's pollution is shown after any treatment provided by the industry.



```
SAMPLING STATION REPORT: POINT SOURCE QUALITY                JURISDICTION 1          ROUND 2

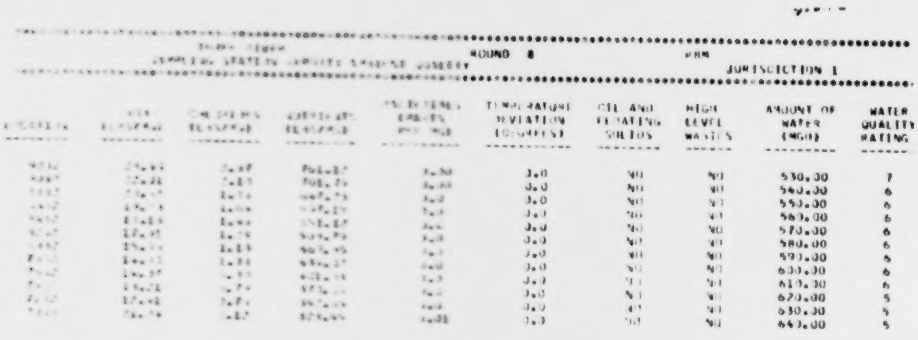
                    BUSINESS   TREATMENT                                                       BACTERIALS  TEMPERATURE  OIL AND   HIGH
                    TYPE AND   TYPE AND   VOLUME   BOD        CHLORIDES   NUTRIENTS   (PARTS      DEVIATION    FLOATING  LEVEL
LOCATION  OWNER     LEVEL      LEVEL      (MGD)    (LBS/MG)   (LBS/MG)    (LBS/MG)    PER MG)     (DEGREES)    SOLIDS    WASTES
```

The report is a table consisting of one row per sampling station. The first column shows the coordinates of the activity whose effluent is being sampled. Next are the economic owner and the type and operating level of the activity. The fourth column shows the effluent treatment type and level provided by the activity, but is relevant for basic industries only. A level one treatment plant has the capacity to process all of the effluent normally generated by one level of industry.

The volume of effluent (in MGD) is next. Basic industries which use surface water can recycle some of their water and cut the amount of effluent generated by up to half of the normal amount. Although the amount of effluent can be cut, the amount of pollution generated remains the same. Thus, the pollution concentration is higher in effluent when water is recycled, but no more pollution is present than there would be if there were no recycling.

The remainder of the table shows the concentration of each pollutant in the activity's effluent.

Sampling station report: Ambient quality



```
                                                   ROUND  8                         [illegible]
  [illegible]                                                                         JURISDICTION 1

[illegible]  [illegible]  [illegible]  [illegible]  [illegible]   TEMPERATURE   OIL AND    HIGH    AMOUNT OF   WATER
                                                                   DEVIATION    FLOATING   LEVEL     WATER     QUALITY
                                                                   (DEGREES)     SOLIDS    WASTES    (MGD)     RATING
                                                                   ---------    --------   ------  ---------   -------
                                                                      0.0          NO        NO      530.00       7
                                                                      0.0          NO        NO      540.00       6
                                                                      0.0          NO        NO      550.00       6
                                                                      0.0          NO        NO      560.00       6
                                                                      0.0          NO        NO      570.00       6
                                                                      0.0          NO        NO      580.00       6
                                                                      0.0          NO        NO      590.00       6
                                                                      0.0          NO        NO      600.00       6
                                                                      0.0          NO        NO      610.00       6
                                                                      0.0          NO        NO      620.00       5
                                                                      0.0          NO        NO      630.00       5
                                                                      0.0          NO        NO      640.00       5
```

An ambient sampling station measures the concentration of each pollutant in the surface water as it leaves a parcel and moves to the next parcel. Ambient sampling stations can be set up on any surface water parcels in the jurisdiction at a fixed cost per parcel. The type of information provided on the ambient sampling station report is basically the same as on other sampling station reports, except that the amount of water is the amount in the surface water, and the water is rated in a quality category (1-9).

(Note: For more detailed explanation see page **51**.)

Municipal Treatment Plant Map

A Utility Department supplies water to all economic activities except some basic industries which obtain their own water from the surface water. Each utility district is also a water district. A parcel is supplied with municipal water and sewer service when utilities are installed on the parcel. The department can decide where to intake water, where to dump sewage, how much intake water it will provide, how much sewage treatment it will provide, and where treatment facilities will be located.

Municipal water intake and sewage treatment plants are located in the utility districts which they serve. An intake treatment plant processes the surface water removed from the parcel on which its intake point is located (not necessarily within the water district which it serves). All water treated by an intake treatment plant is processed to drinking water quality. The quality of the water before it is treated varies with the amount of pollution in the surface water where the intake point is located. There are nine water quality ratings, 1 being the best quality and 9 being the worst. A parcel's water quality rating is based on the volume of water on the parcel and the amount of pollution entering it from adjoining parcels.

Water quality rating:	Description:
1	Drinkable - best quality water
2	Drinkable - with minor treatment
3	Swimmable - direct body contact
4	Boating and Fishing - indirect body contact
5	Fair esthetic value
6	Poor esthetic value - treatable at moderate cost
7	No esthetic value - treatable at high cost
8	Negative esthetic value - treatable at very high cost
9	Unusable water

Seven types of pollutant are measured for the quality rating:

Pollutants:	Description:
BOD	Biochemical Oxygen Demand; the natural breakdown of this pollutant causes a decrease in the concentration of dissolved oxygen in the water.
Chlorides	Chlorides are employed as an indicator of persistent pollutants.
Nutrients	Phosphate, nitrite, nitrate, nitrogen, and phosphorous.
Coliform Bacteria	Indication of the potential health hazard of a given body of water.

Pollutants:	Description:
Temperature	A measure of the deviation from the normal temperature of the surface water.
Oil and floating solids	Any oil added to the system and all floating solids such as refuse, garbage, boards, tires, etc.
High-level wastes	Highly toxic, non-degradable substances.

The quality of water at a district's intake point affects, among other things, the cost to process the water to drinking water quality. The water quality of a parcel is shown on the Water Quality Map. That quality is not affected by any pollution dumped on the parcel, only by pollution dumped on upstream parcels.

An inflow treatment plant, while able to make all but the worst (quality 9) water drinkable, has a capacity which is a function of its level. The amount of water which a district needs is a function of the needs of the activities located in the district, but the amount of water which a district can obtain may be limited by its inflow treatment plant capacity. Whenever a district cannot obtain all of its needed water for any reason, including insufficient inflow treatment plant capacity, the activities served by the district purchase that proportion of their water needs which cannot be met locally from the Outside at a high cost. The cost to construct an inflow treatment plant increases with the number of levels constructed. Unlike levels of other activities in the model, municipal treatment plant costs and capacities are not necessarily even multiples of "level one" costs and capacities. The land requirements, however, are multiples of level one.

Municipal sewage treatment plants can be constructed not only to different levels (capacities) but also to different types of treatment. The types of sewage treatment are, in increasing order of pollution removal:

Chlorination (CL)
Primary treatment (PT)
Secondary treatment (ST)
Tertiary treatment (TT)

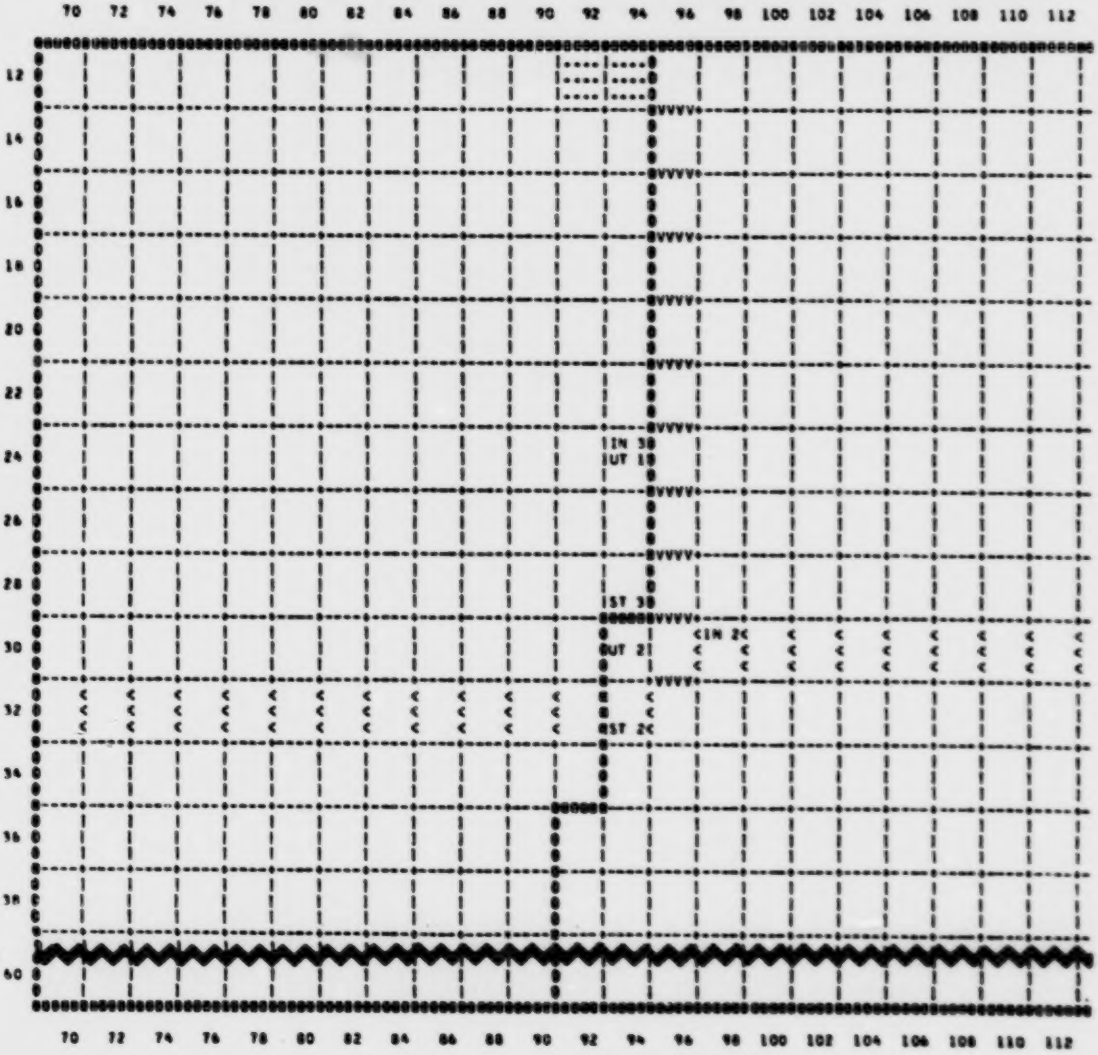
Tertiary treatment requires the three other types of treatment; secondary treatment requires chlorination and primary treatment. The level of treatment printed on the map is the level of the type printed and of all lesser types. There is no provision for the case of different levels of different types of treatment within a single district.

Since treatment plants have fixed capacities which vary by their levels, any district's sewage in excess of its plant's capacity flows untreated into the surface water on the parcel on which the district's outflow point is located.

Note that all of a district's intake treatment must be located on a single parcel. Likewise, all of its sewage treatment must be on a single parcel, although that parcel does not have to be the same one as that on which its intake treatment plant is located.

'UT' appears in the middle row of a parcel if there is a utility plant on the parcel. Next to the 'UT' is the code number of the utility plant. That number matches the number printed next to the district's intake and outflow points on the Municipal Inflow and Outflow Point Map.

```
                                   TWOCITY
                          MUNICIPAL TREATMENT PLANTS                                ROUND  1
```


70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40
IN 3
UT 1
ST 3
IN 2
UT 2
ST 2

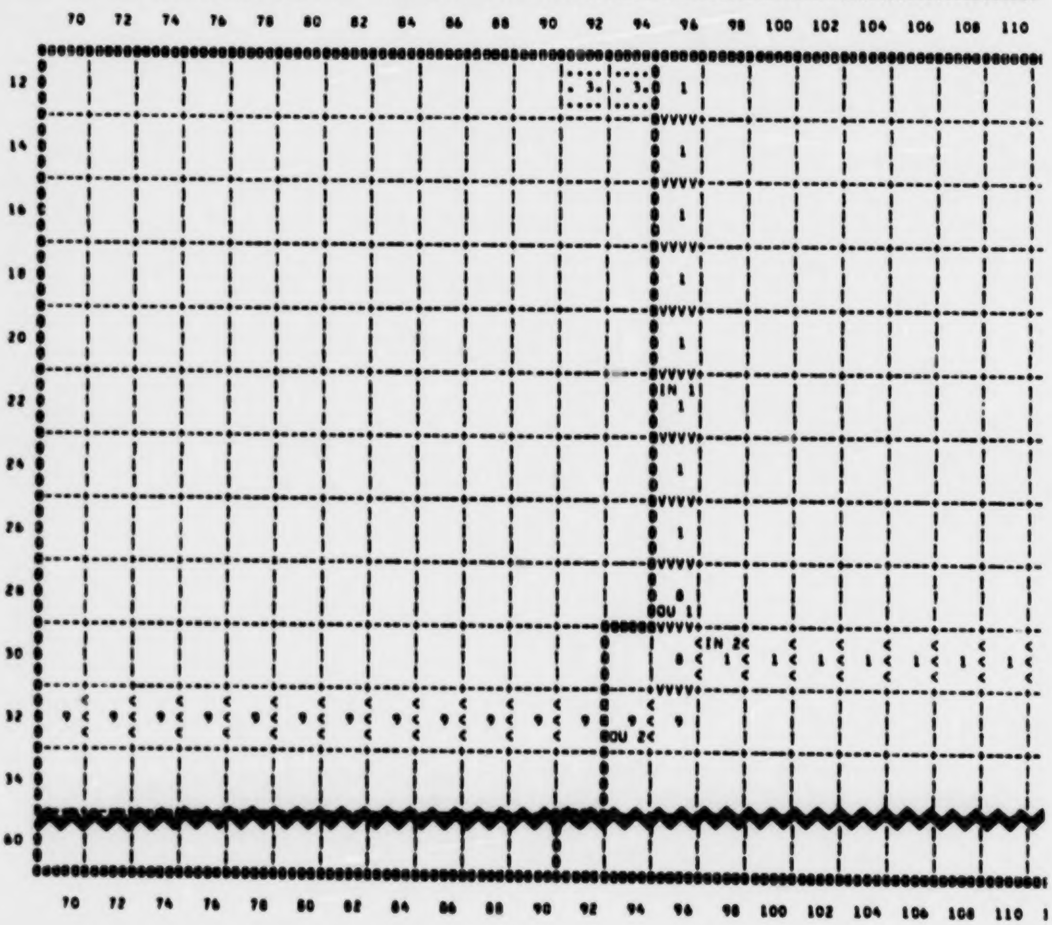
```
PARCELS                                                   PARCEL EDGES
-------                                                   ------------
TOP LEFT: IN FOR MUNICIPAL INTAKE                         >AV<  DIRECTION OF FLOW
          TREATMENT PLANT
TOP RIGHT: LEVEL OF INTAKE TREATMENT PLANT                ----  NO WATER FLOWING
MIDDLE LEFT: UT FOR UTILITY DISTRICT PLANT                      BETWEEN PARCELS
MIDDLE RIGHT: CODE NUMBER OF UTILITY DISTRICT
BOTTOM ROW: MUNICIPAL EFFLUENT TREATMENT TYPE AND LEVEL   0000  UTILITY DISTRICT BOUNDARY
                                 ....
                                 ....  LAKE PARCELS
                                 ....
```

Municipal inflow and outflow point map

Unlike treatment plants, municipal intake and outflow points do not have to be located within the districts which they serve. This map shows where each district's intake and outflow points are located. The code number next to the 'IN' or 'OU' on the map is the code number of the utility plant in the district which the point serves.

Each district has one intake point and one outflow point. However, there can be more than one inflow and outflow point on a parcel. The map shows only one point, so if there is more than one on a parcel, only the Utility Department Report will note the existence of all of the others.

```
                         TWOCITY
                MUNICIPAL INFLOW AND OUTFLOW POINTS                                  ROUND  1
```



```
PARCELS                                                    PARCEL EDGES
-------                                                    ------------
TOP LEFT: IN FOR MUNICIPAL INFLOW POINT                    >AVC  DIRECTION OF FLOW
TOP RIGHT: CODE NUMBER OF UTIL'TY DISTRICT INTAKING        ----  NO WATER FLOWING
MIDDLE ROW: SURFACE WATER QUALITY RATING                         BETWEEN PARCELS
BOTTOM LEFT: OU FOR OUTFLOW POINT                          0000  UTILITY DISTRICT BOUNDARY
BOTTOM RIGHT: CODE NUMBER OF UTILITY DISTRICT DISCHARGING

                         ....
                         ....  LAKE PARCELS
```

Water quality map

The surface water quality on a parcel is a function of the pollution entering the parcel from adjoining parcels and of the amount of water on the parcel itself. The water quality on a parcel is not affected by any dumping activity on the parcel itself. Any activity which removes water from a parcel does so at the quality shown on the Water Quality Map.

Quality is the only characteristic of surface water which can change during a run of the model. The other characteristics (rate of flow, volume, and surface area) are constant.

Water Sampling Stations can be set up to measure the exact pollution content of the water flowing out of parcels. Sampling stations can also be established to measure the pollution content of water generated by either individual economic activities or municipal systems. The operation of a sampling station is charged to the Utility Department of the jurisdiction in which the station is located.

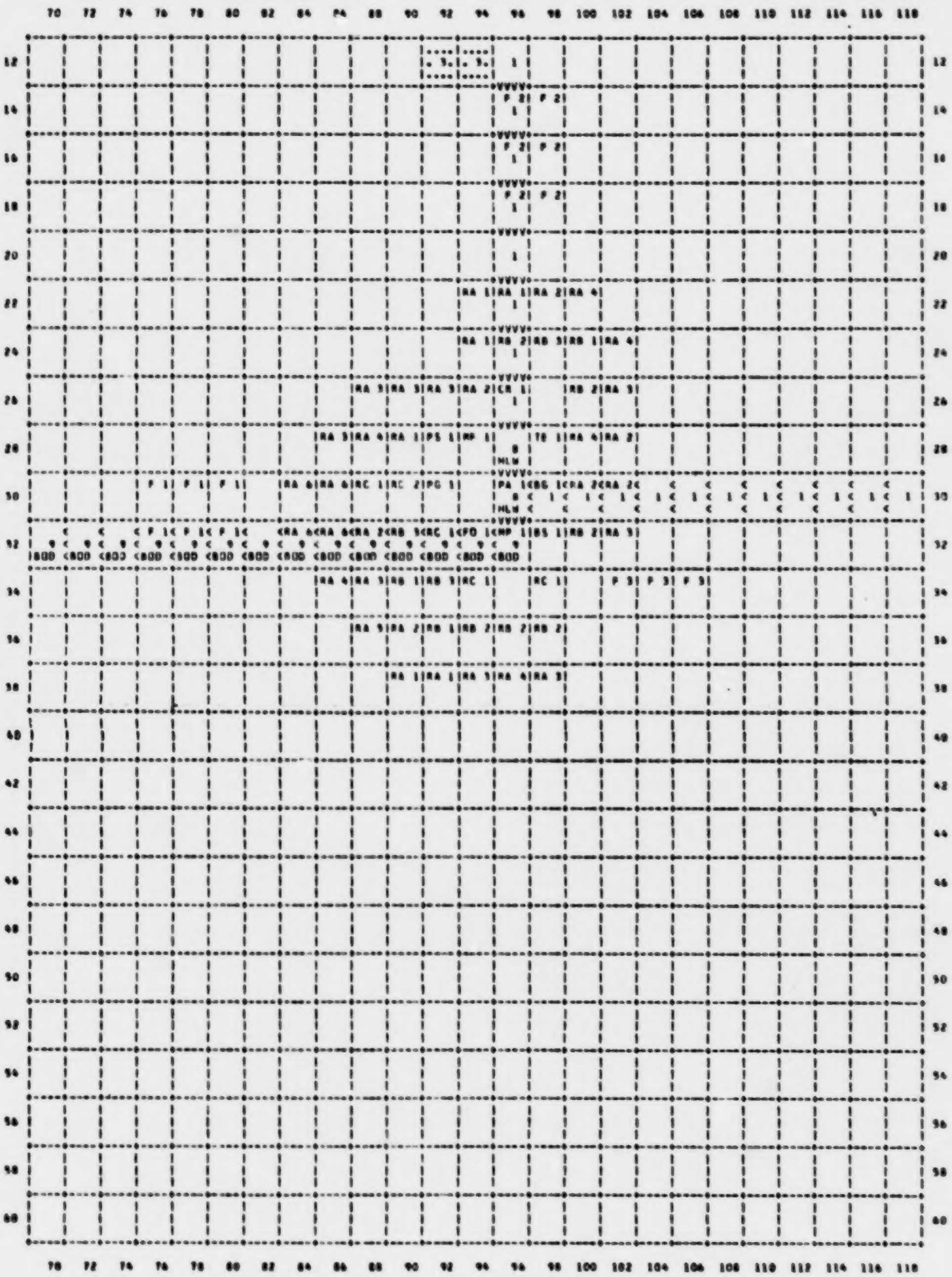
The figure on the next page illustrates the processes which affect surface water pollution. The pollution flowing into a parcel from adjoining parcels is mixed in the water on the parcel. The pollution concentration per MGD is then measured and the water is rated in one of the nine water quality categories. The water quality rating is the worst rating category generated in any single pollutant. The rating allows no trade-off between a pollutant which is present in very low concentration and one which is very highly concentrated.

Next, water is removed if there are any intaking activities on the parcel. There are two types of intaking activities: 1) basic industries of the types which require surface water; and 2) municipal intake points. There can be only one economic activity on a parcel, and if it is a surface-water user, it intakes and dumps on the parcel on which it is located. Municipal intake water is sent to the municipal intake treatment plant and from there to activities served by the district.

The surface water which is not removed undergoes a biological change process in which some of the pollutants decay naturally. That water is mixed with any water dumped on the parcel. There are three types of activities which can dump on a parcel. In addition to basic industries and municipal outflow points, farm runoff can add to the pollution on a parcel. Whereas basic industries and municipalities can treat their effluent and thus remove some or all of their pollution, farm pollution can be cut back only if the farm owner decreases the amount of fertilizer used on the farm. The total amount of pollution is then moved on to the next parcel on the river.

The water quality map shows where rivers and economic activities are located in addition to water quality.

```
                    TWOCITY
               WATER QUALITY MAP                                                   ROUND  1
```



70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
P 2 P 2
RA 1 RA 1 RA 2 RA 4
RA 1 RB 2 RB 3 RB 1 RA 4
RA 3 RA 3 RA 3 RA 2 CR 1 RB 2 RA 3
RA 3 RA 4 RA 1 PS 1 MP 1 TO 1 RA 4 RA 2
MLW
P 1 P 1 P 1 RA 6 RA 6 RC 1 RC 2 PG 3 PA 1 CBG 1 CPA 2 CRA 2
P 1 P 1 P 1 RA 6 RA 6 RA 2 RB 3 RC 1 PD 1 MP 1 BS 1 RB 2 RA 3
BOD
RA 4 RA 3 RB 1 RB 3 RC 1 RC 1 P 3 P 3 P 3
RA 3 RA 2 RB 1 RB 2 RB 2 RB 2
RA 1 RA 1 RA 3 RA 4 RA 3

```
PARCELS                                             PARCEL EDGES
-------                                             ------------
   TOP ROW: ECONOMIC ACTIVITY TYPE                  ><V<  DIRECTION OF FLOW
            AND OPERATING LEVEL
            FARM TYPE IF FARM ON PARCEL             ----  NO WATER FLOWING
MIDDLE ROW: SURFACE WATER QUALITY RATING                  BETWEEN PARCELS
BOTTOM ROW: WORST POLLUTANT

....
....  LAKE PARCELS
```

Water usage map

Basic industries can treat their effluent in order to remove pollutants. An industry's effluent treatment plant is located on the same parcel as the industry and does not consume land. Like municipal effluent treatment plants, industrial treatment can be of four types: chlorination (CL), primary treatment (PT), secondary treatment (ST), and tertiary treatment (TT). Industrial treatment plants can be constructed to any level and each treatment plant level has the capacity to treat all of the effluent of a level of the industry type which it is constructed to serve. (See Economic Sector Master Tables, p. **133**). The construction cost of a level of treatment plant varies by treatment type and type of industry.

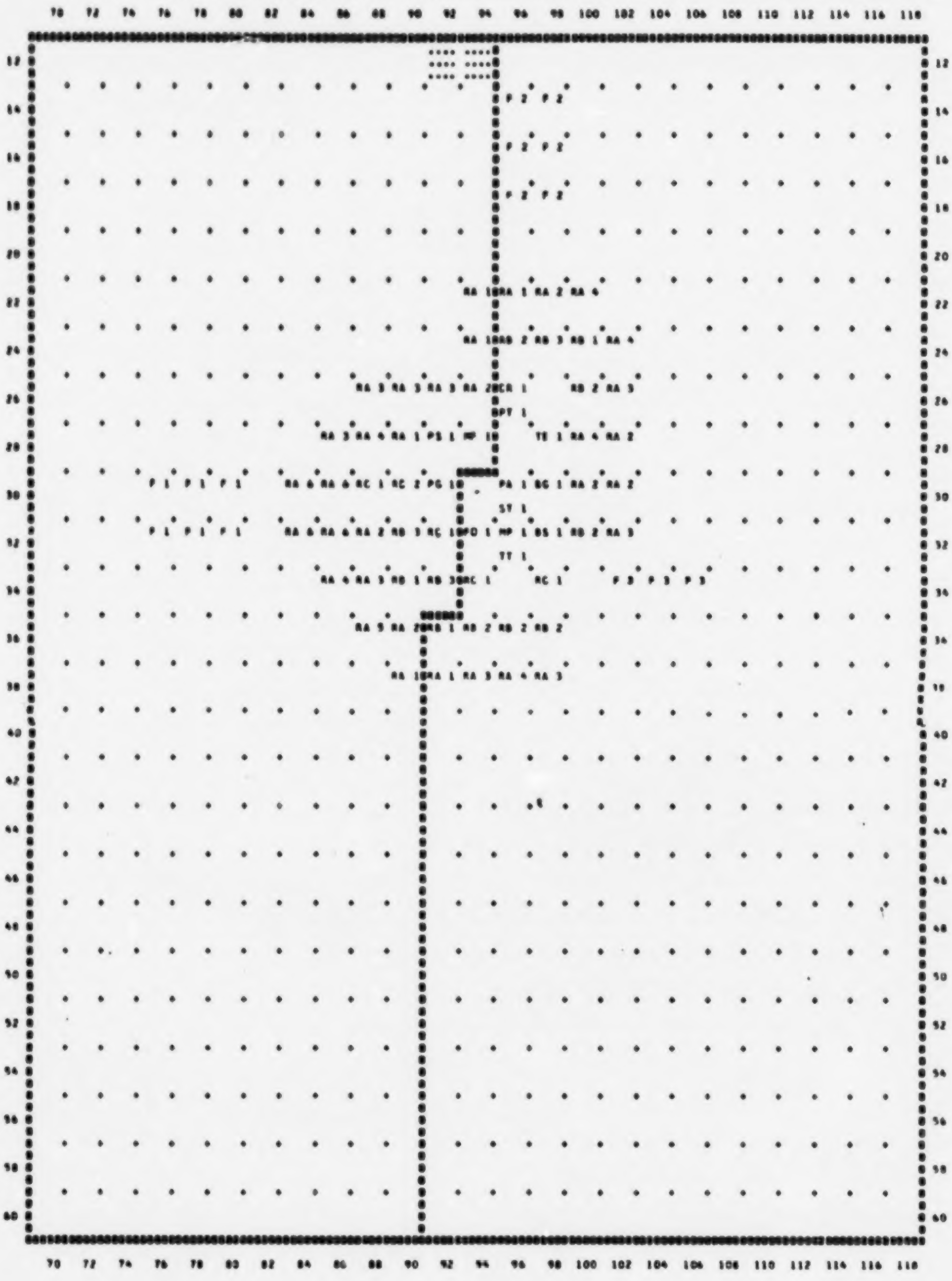
Industries can recycle up to half of their effluent. Recycled water is not processed through an effluent treatment plant. Its treatment is a process distinct from industrial intake or outflow treatment and costs a fixed number of dollars per MG recycled. So, a level two industry at a *recycle level* of 100% would be reusing (recycling) *half* its effluent. Now, if it also had a level one treatment plant (which is capable of handling half the effluent from a level two industry) it would be processing all of its effluent. On the other hand, if the recycle level was 50%, then the industry would be reusing one fourth of its effluent. This leaves 75% of the effluent to be treated by the level one treatment plant. Now, since this plant could treat 50% of the effluent of a level two industry, it can still treat 50/75 or two thirds of the effluent given a 50% recycle level. This would leave one third of the non-recycled portion or one-fourth of the total **water volume** of effluent untreated.

Unlike municipal water intake treatment facilities, industrial intake treatment is assumed to exist when the industry is constructed and it is assumed to have the capacity to treat all of the water required by the industry. Like municipal intake treatment costs, industrial intake treatment costs increase as water quality declines. The worst water (quality 9) cannot be treated, in which case the industry is forced to pay a high cost for water, the cost represented by the Outside price of water. Furthermore, intake water quality affects the depreciation of surface water users, a reflection of wear on treatment equipment.

Regardless of the amount of recycling, intake water quality has the same effect on industrial depreciation. The volume treated does not matter. The assumption is that recycled water goes through intake treatment, so no wear and tear on treatment equipment has been avoided.

TWOCITY
WATER USAGE MAP

ROUND 1


70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 116 118
12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60
F 2 F 2
F 2 F 2
F 2 F 2
RA 10RA 1 RA 2 RA 4
RA 10RB 2 RB 3 RB 1 RA 4
RA 3 RA 3 RA 3 RA 20CR 1 RB 2 RA 3
BPT 1
RA 3 RA 4 RA 1 PS 1 MP 10 TE 1 RA 4 RA 2
F 1 F 1 F 1 RA 6 RA 6 RC 1 RC 2 PG 10 PA 1 BG 1 RA 2 RA 2
ST 1
F 1 F 1 F 1 RA 6 RA 6 RA 2 RB 3 RC 10PO 1 MP 1 BS 1 RB 2 RA 3
TT 1
RA 4 RA 3 RB 1 RB 30RC 1 RC 1 F 3 F 3 F 3
RA 5 RA 20RB 1 RB 2 RB 2 RB 2
RA 10RA 1 RA 3 RA 4 RA 3

PARCELS

TOP ROW: ECONOMIC ACTIVITY TYPE
AND OPERATING LEVEL
MIDDLE ROW: (FOR BASIC INDUSTRIES)
PERCENT OF WATER RECYCLED
BUTTOM ROW: (FOR BASIC INDUSTRIES)
EFFLUENT TREATMENT
TYPE AND LEVEL

....
.... LAKE PARCELS
....

PARCEL EDGES

XX XX UTILITY DISTRICT BOUNDARY
OO OO JURISDICTION BOUNDARY
BB BB BOTH

Utility department decisions

The decisions which the Utility Department can make fall into two categories: those which are jurisdiction-wide in scope and those that pertain to individual parcels and districts.

Jurisdiction-wide:
  Change utility prices
  Change water prices
  Transfer cash

Individual parcels or districts:
  Buy or sell
  Install or change utility service
  Construct or demolish a utility plant
  Construct a water intake treatment plant
  Construct a sewage (outflow) treatment plant
  Change a water intake point
  Change a water outflow point
  Create or remove a water sampling station

The department may make as many of each of those decisions as it wishes. It may choose to make no decisions, in which case price policies and facilities operate as they did in the previous year. No new development or cash transfer is undertaken.

Water quality officer decisions

Legislative options:

Require a certain minimum level of treatment at all effluent discharge points.
- Required only of industries
- Required only of municipal systems
- Required of all

Allow an absolute maximum quantity or concentration of pollutants.
- in quantity of a specific pollutant/MG
- in total quantity of a specific pollutant (LBS, parts, etc.)

Economic options:

Charge an effluence tax
- Charge tax per quantity of pollutants discharged (by type)
- Charge tax per concentration of pollutants discharged
- Charge tax according to the size of operation of the polluting activity
  - o according to quantity of effluent
  - o according to gross or net income

Issue permits
- Set price for permit, with each permit allowing a specific quantity of pollutants.
- Limit number of permits and allow open market bidding.

Enforcement options:

Legislative action

- Fines in absolute or graduated amounts
- Shut down of plant

Direct fines levied not by legal system but by Water Department

Decision-making options:

Locate and operate sampling stations

Select ambient standards

Choose regulative option

Enforce chosen regulative option

nput format

Local system decision-makers (such as the Utility Department) use a standardized input form when making decisions that must be processed by the computer. The standard message format is:

- *$CODE/ = dm/a, b, c, d, ...*

$CODE stands for the type of decision code. The UT Department has the option to make decisions that use the following decision codes.

$OTHER (utility prices)
$CVPT (utility service)
$CASH (transfer cash)
$PU (land transfer)
$OUBLD (construct or demolish)
$WRBLD (treatment plants, intake and outflow points, sampling stations)
$WRPRC (water prices)

"=dm" is the decision-maker, which for the utility department is *UT1*, *UT2*, or *UT3*, depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the *UT* decision-maker code, even if there is only one active jurisdiction.

The columns *"a"*, *"b"*, and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "Ø" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER
BASIN
MODEL

Decision Code | Decision-Maker | a | b | c | d | e | f | g | h | i | j | k

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / _____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____
$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

Utility department: Input explanation form

Type of Decision	Code	Decision-maker	a	b	c	d	e	f	g
Purchase or bid on land	$PU	UT1, UT2, or UT3	location	price (in $1000's)	seller (economic decision-maker or department or OU)	percent of parcel (0 if all)			
Change utility service	$CVPT	UT1, UT2, or UT3	US	location	location of plant serving	new level of service			
Set utility prices	$OTHER	UT1, UT2, or UT3	P	new price per unit of utility service					
Construct, upgrade or demolish a utility plant	$OUBLD	UT1, UT2, or UT3	site location	UT	old level (0 if new plant)	new level			
Transfer cash	$CASH	UT1, UT2, or UT3	C	receiver (economic or social decision-maker or department or jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving PVT; if class receiving (H, M, or L); if department receiving, to CAPital or CURrent account	0	if social receiving, location receiving
Set water prices	$WRPRC	UT1, UT2, or UT3	two-letter activity code (AL for all water users)	price per MG					

Type of Decision	Code	Decision-maker	a	b	c	d	e	f	g
Build or demolish intake treatment plants	SWRBLD	UT1, UT2, or UT3	T	location	IN	old level	new **level**	location of utility plant serving district	
Build or demolish outflow treatment plants	SWRBLD	UT1, UT2, or UT3	T	location	OUT	old level	new level	location of utility plant serving district	**type of treatment plant**
Locate intake and outflow treatment points	SWRBLD	UT1, UT2, or UT3	P	location	IN if intake, OUT if outflow	0	0	location of utility plant serving district	
Locate water sampling stations	SWRBLD	UT1, UT2, or UT3	S	location (if sample of municipal **outflow, give location of uti**lity plant **in** district in which outflow point serves)	A, if ambient, P if industrial effluent, M if municipal outflow point	**0 if new, 1 if sampling point removal**	**0 if sampling point removal, 1 if new**		

Sample decisions for the utility department

Jurisdiction-wide decisions:

Change utility prices - The Utility Department in Jurisdiction 1 sets the price for a unit of utility at $11,000.

Decision Code **Decision-Maker** a b c d e f g

$ OTHER / = UT1 / P , 11000, ____, ____, ____, ____, ____,

Change water prices - The Utility Department in Jurisdiction 1 set all the water prices to $450 per MG. The Utility Department used selective pricing and set the price for TE at $400/MG, for MF at $350/MG, and for HA at $475/MG. The price of water to all the other municipal users remained at the previous level.

$ WRPRC / = UT1 / AL , 450, ____, ____,
$ WRPRC / = UT2 / TE , 400/ MF , 350,
$ WRPRC / = UT2 / HA, 475

Transfer cash - The Utility Department in Jurisdiction 3 transferred $250,000 from its capital account to its current account.

$ CASH / = UT3 / C , UT3, 250000, CAP, CUR, ____,

Parcel or district-specific decisions:

Purchase land - The Utility Department in Jurisdiction 2 purchased 10 percent of the land on parcel 9642 from Team A for $650,000. This land may be used to construct a utility plant and/or a water treatment plant.

$ PU / = UT2 / 9642, 650 , A , 10 , ____,

Change utility service - The Utility Department in Jurisdiction 1 decides to provide level 5 utility service to parcel 9850 from its utility plant at 10054. Parcel 9850 must be contiguous to a parcel that is presently receiving utility service from the plant at 10054.

$ CVPT / = UT1 / US , 9850 , 10054, 5 , ____, *Construct a utility plant* - The Utility Department in Jurisdiction 1 decides to construct a level 2 utility plant on the land it owns on parcel 10248.

```
$OUBLD / =UT1 / 10248, UT , 0 , 2 , ____, ____, ____,
```

Construct intake and outflow plant - The Utility Department decides to build a level 2 intake plant at 10444 and a level 2 outflow plant with tertiary treatment (TT) at 10850 and associate these with the water and utility district serviced by the new utility plant at 10248.

```
$WRBLD/ =UT1 / T , 10444, IN , 0 , 2 , 10248, ____,
$WRBLD/ =UT1 / T , 10850, OUT, 0 , 2 , 10248, TT ,
```

Locate intake and outflow points - The Utility Department in Jurisdiction 1 decides to plac the intake point for the water district served by the utility plant at 10248, at 10644 and the outflow point at 11050.

```
$WRBLD / =UT1 / P , 10644, IN , 0 , 0 , 10248, ____,
$WRBLD / =UT1 / P , 11050, OUT, 0 , 0 , 10248, ____,
```

Locate sampling stations - The Utility Department in Jurisdiction 3 decides to operate an ambient sampling station at 7618 and close down an ambient sampling station at 7820. Furthermore, it decides to measure the outflow - pollution of the water district defined by the utility plant at 7836 and to measure the pollution being dumped by the CR3 on parcel 8038.

```
$WRBLD / =UT3 / S , 7618, A , 0 , 1 / S , 7820, A , 1 , 0
$WRBLD / =UT3 / S , 7836, M , 0 , 1 , ____, ____, ____,
$WRBLD / =UT3 / S , 8038, P , 0 , 1 , ____, ____, ____,
```

MASTER TABLES FOR THE UTILITIES DEPARTMENT

PLANNING MASTER TABLE
(LEVEL ONE CHARACTERISTICS)

ACTIVITY	Percent of a Parcel	(Maximum Possible Levels)	Minimum Level of Utility Service	Annual Utility Units Consumed	Construction Costs (Market Value)	Full Time Employees PH	PM	PL	Terminal Units	MS Drain (MS Capacity Units)
FL	28	(3)	1	50	300	8	8	35	1000	150
SG	40	(2)	1	100	240	14	18	23	10000	50
MP	48	(2)	7	700	240	19	18	18	6000	200
MF	20	(5)	1	100	320	24	18	17	2000	150
NL	15	(6)	1	100	150	21	20	18	1000	100
EL	12	(8)	2	200	140	30	18	17	1000	150
TE	12	(8)	2	200	180	25	22	15	2000	200
FO	20	(5)	3	300	230	15	19	24	3000	250
TA	6	(16)	1	100	120	15	10	30	1000	150
PA	16	(6)	3	300	250	23	17	20	3000	200
CR	28	(3)	4	400	250	24	24	14	3000	300
NS	12	(8)	1	76	50	23	9	9	NA	50
BG	12	(8)	2	112	25	14	7	8	One per CU sold	25
BS	10	(10)	1	71	10	20	9	9	NA	10
PG	12	(8)	1	99	30	8	13	23	NA	30
PS	12	(8)	1	77	10	6	11	16	NA	10
RA	2	(50)	1	4	1	NA	NA	NA	NA	10
RB	2	(50)	1	26	6	NA	NA	NA	NA	60
RC	2	(50)	2	117	25	NA	NA	NA	NA	250

Pollution Characteristics of Economic Activities

	Water Consumption			Pollution Generated						
				Pounds Per Mg			Parts Per MG			
Surface Water Users	MGD	Days Per Year	MGY	BOD	CL	NU	COLI	Temperature	OFS	HLW
FL	61	260	15,860	600	100	1000	20	9	1	0
MP	225	260	58,500	1000	170	500	20	6	1	0
FO	49	260	12,740	6000	400	10000	300	9	1	0
TA	17	260	4,420	6000	130	4000	20	18	1	1
PA	333	260	86,580	3000	380	3000	150	16	1	1
CR	31	260	8,060	2000	500	8000	50	4	1	1
Municipal Water Users										
Industries										
SG	10	260	2,600	500	100	1000	10	0	0	0
MF	9	260	2,340	500	150	700	30	0	1	0
NL	12	260	3,120	400	150	100	20	0	0	0
EL	5	260	1,300	800	200	200	20	0	0	0
TE	8	260	2,080	500	180	100	30	0	0	0
Commercial										
NS	.18	260	47	100	0	0	20	0	0	0
BG	.13	312	41	200	0	0	10	0	0	0
BS	.17	312	53	150	0	0	15	0	0	0
PG	.23	312	72	250	0	0	20	0	0	0
PS	.18	312	56	100	0	0	15	0	0	0
Residential										
HA	.08	364	29	1250	50	100	5	0	1	0
HB	.07	364	25	1250	50	100	5	0	1	0
HC	.06	364	22	1250	50	100	5	0	1	0
MA	.07	364	25	1100	40	80	5	0	1	0
MB	.05	364	18	1100	40	80	5	0	1	0
MC	.03	364	11	1100	40	80	5	0	1	0
LA	.03	364	11	1000	30	70	5	0	1	0
LB	.03	364	11	1000	30	70	5	0	1	0
LC	.02	364	7	1000	30	70	5	0	1	0

Percent Pollution Removed by Treatment Types

	CL	PT	ST	TT
BOD	0	50	80	99
Chlorides	0	0	60	99
Nutrients	0	0	50	70
Coliform	99	99	99	100
Temperature	0	0	0	100
Oil and Floating Solids	0	100	100	100
High Level Wastes	0	0	0	100

UTILITY DEPARTMENT MASTER TABLE

	Utility (unit)	Water (MG)
Normal Price of Service	$10,000	1/

	Utility Plant	Utility Level	Intake	Outflow
Land Requirement	6%	None	1%	1%

Intake Treatment Costs per MG

Water Quality Level

	1	2	3	4	5	6	7	8	9
UT	5	60	80	100	180	300	450	600	N.A.

Annual Cost to Operate an Ambient Water Quality Sampling Station ...$50,000
Annual Cost to Operate a Point Source Water Quality Sampling Station.$25,000

1/ Water prices may be set by type of user

Elimination of Three Pollutants Due to Time in the Water

Rate of Flow of the River (parcels per day)	Percent of original pollutant remaining at end of parcel flow BOD	Nutrients	Coliform
1	50	33	17
2 (sluggish)	75	67	58
4	89	83	79
6 (slow)	92	89	86
8	96	92	90
11 (average)	96	94	93
15	97	96	95
22 (fast)	97	97	96
30	98	98	97
44 (rapid)	99	99	98

MASTER SHEET FOR THE UTILITY DEPARTMENT

General Characteristics

Level of Service	Installation Costs (million)	Number of Utility Units Installed
1	2	100
2	4	200
3	5	300
4	6	400
5	8	500
6	11	600
7	14	700
8	18	900
9	35	2,500

Operating Costs for a UTI as a Function of the Number of Utility Units Served

Utility Units Served	Per Unit Operating Costs	Total Operating Costs
300	$20,000	$6,000,000
600	13,333	8,000,000
900	9,630	8,666,667
1200	7,778	9,333,333
*1500	*6,667	*10,000,000
1800	7,407	13,333,333
2100	7,936	16,666,666
2200	8,080	17,777,778

*The least cost design capacity of a UTI.

CHARACTERISTICS OF OUTFLOW TREATMENT PLANTS

	Level of Treatment Plant							
	1	2	3	4	5	6	7	8
Maximum Capacity (MGD)	3	8	16	26	40	60	90	200
Land Requirement (% of Parcel)	1	2	3	4	5	6	7	8
Construction Costs (millions of dollars)								
CL	.1	.2	.4	.6	.8	1.0	1.2	1.6
PT	.5	1.0	2	3	4	5	6	8
ST	1.5	3.0	6	9	12	15	18	24
TT	4.5	9.0	18	27	36	45	54	72
Operating Costs (dollars per MG)								
CL	25	24	23	22	21	20	19	18
PT	100	95	90	85	80	75	70	65
ST	200	190	180	170	160	150	140	130
TT	300	285	270	255	240	225	210	195

Intake treatment plants have the same construction costs as ST outflow treatment plants.

WATER MASTER TABLE

Physical characteristics: Location (parcel number); Type (river or lake); Volume flowing to next parcel (MGD); Rate of flow (parcels per day).

Quality of water:

Rating:	Comment:
1	Drinkable -- best quality water
2	Drinkable with minor treatment
3	Swimable -- direct body contact possible
4	Boating and fishing -- indirect body contact
5	Fair esthetic value
6	Poor esthetic value -- treatable at moderate cost
7	No esthetic value -- treatable at high cost
8	Negative esthetic value -- treatable at very high cost
9	Non-usable water

Types of Pollution

	Name	Units of Measure
BOD	Biochemical Oxygen Demand	Pounds per million gallons of water
CL	Chlorides	LBS/MG
NO_3	Nutrients	LBS/MG
CO	Coliform Bacteria	Parts per Million gallons
T	Temperature Deviation	Degrees (^{o})
OFS	Oil and Floating Solids	Yes or No
HLW	High Level Waster	Yes or No

BIODEGREDATION OF POLLUTANTS

Eleven parcels per day is the typical normal rate of flow of water in the RIVER BASIN MODEL. The following table shows the percent or amount of each pollutant if the water volume does not vary and the rate of flow of the river is eleven parcels per day.

	BOD	NUTRIENTS	COLIFORM	TEMP	O&S HLW
Start	100%	100%	100%	10°	1
Parcels Downstream					
1	96	94	93	10°	1
2	92	88	86	7°	1
3	88	83	80	4°	1
4	84	78	74	1°	1
5	81	73	69	0	1
6	78	69	64	0	0
7	75	65	60	0	0
8	72	61	56	0	0
9	69	57	52	0	0
10	66	54	48	0	0
11	63	52	45	0	0
12	60	49	42	0	0
13	58	46	39	0	0
14	56	43	36	0	0
15	54	40	33	0	0

Definition of the Nine Comprehensive Water Quality Levels

Pollutant Types (Maximums)	Water Quality Levels 1	2	3	4	5	6	7	8	9
BOD (LBS/MG)	10	20	30	40	60	100	150	300	> 300
Chlorides (LBS/MG)	5	10	15	20	30	40	60	80	> 80
Nutrients (LBS/MG)	25	50	100	200	400	800	1600	3200	> 3200
Coliform Bacteria (parts per MG)	2	6	12	20	40	70	120	160	> 160
Temperature	0	0	1	2	4	7	10	14	> 14
Oil & Floating Solids	0	0	0	0	0	> 0	> 0	> 0	> 0
High Level Wastes	0	0	0	0	0	0	0	> 0	> 0

Explanation of the Table

In order to determine the water quality level or index of given amounts of water, take the concentrations of each of the seven pollutant categories and calculate the water quality level based upon each pollutant separately. For example, a BOD concentration of 25 LBS/MG would yield an index of 3, coliform bacteria of 169 parts per MG would yield an index of 9, and the presence of oil and floating solids would allow the water quality to be no better than 6. The worst (highest) water quality index that was calculated using the pollutant types separately, is assigned to the given amount of water. If the water on parcel x had the three pollutants described above, it would be assigned water quality index of 9.

Looked at another way, water quality level 4 is attained when a body of water has concentrations of BOD that exceed 30 but fall below 41, coliform bacteria concentrations above 12 but below 21, etc.

School department

The local School Department is given control of a number of educational resources within the local system. It has the opportunity to allocate these resources in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials and the local citizenry and business community.

The School Department receives appropriations from the chairman of the local jurisdiction. It may not levy its own taxes, but it may float bonds for capital projects with approval from the social sector through a referendum.

The department makes capital expenditures when expanding its educational facilities. Each new level of educational facilities requires a specified amount of land (which must be acquired) and costs a specified dollar amount (see the Master Tables on page **246**). Current expenditures must be made each round to pay teachers' salaries, purchase needed goods and services, and pay off bonds.

Each school facility has an associated school district comprised of parcels of land delineated by the department. The children from all population units living within a school district will attend the local public schools if there is adequate space and a certain level of quality education. School quality is viewed differently by the three income classes, but they base their decisions on the quality of the school facility itself; the ratio of teachers to students, and the ratio of high-income teachers to middle-income teachers. The quantity and quality of local public school services for a district is therefore dependent upon the level of the school facility, its value ratio, and the number of PI's hired from the high and middle class, and the school crowding.

The demand for school services within a district is dependent upon the number and class of population units located within the boundaries of the school district. An overall index of the quality of school services within a school district is derived from the ratio of the school units demanded to the school units supplied. This ratio is multiplied times 100 to arrive at a School Use Index. As the Use Index rises above 100, the quality of service declines. This impacts on population units by making their neighborhood dissatisfaction increase.

The School Department may also supply adult education facilities for the local population in its jurisdiction. The supply of adult education service is dependent upon the number of teachers hired for the adult education program. The demand for adult education services is dependent upon the time allocations by the social sector for public adult education.

School department output

The School Department for each jurisdiction receives three sections of computer output: the School Department report, the construction table, and School Department finances.

School Department report:

This report contains five sections:

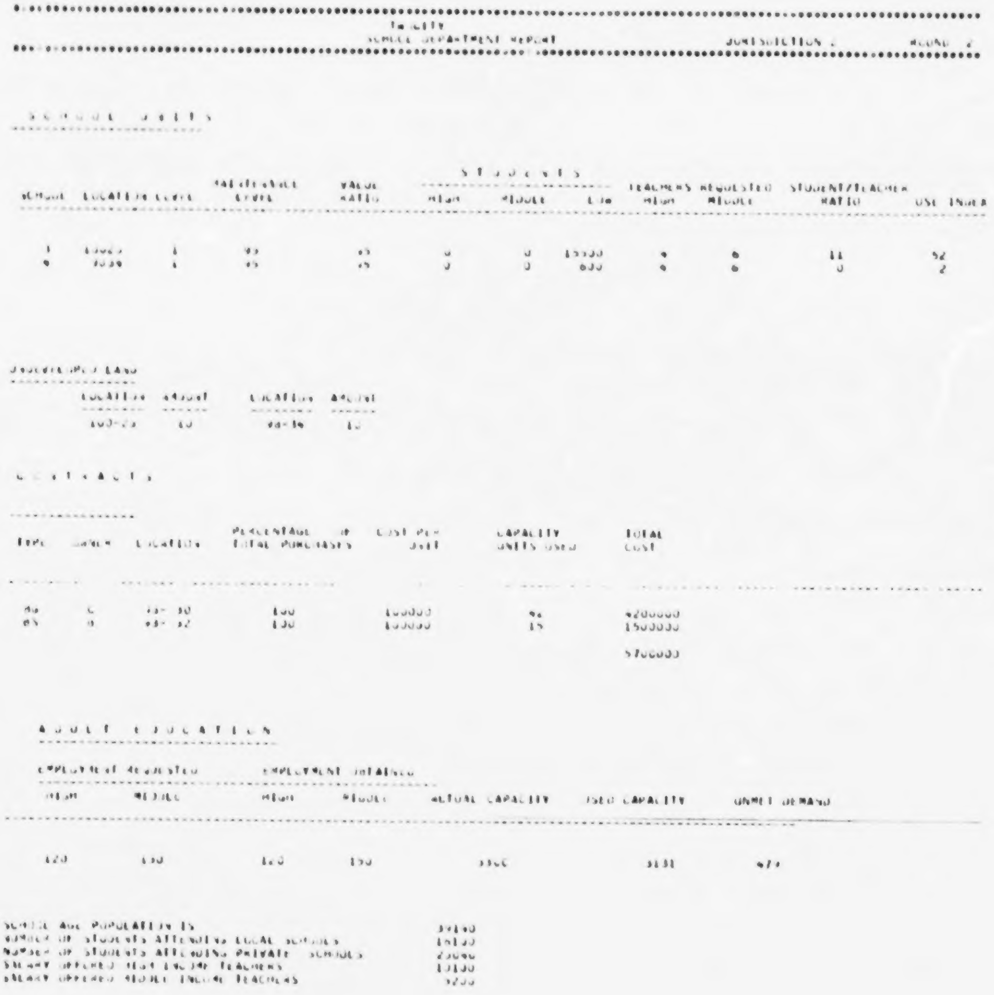
School units - supply, demand and use index for each school district.

Undeveloped land - location and amount of undeveloped land owned by the department.

Contracts - contractual agreements to purchase business goods and services from specific suppliers.

Adult education - supply of and demand for adult education programs.

Boycotts - information on social classes boycotting School Department jobs.



School Facilities

The first column gives the numerical identification of the school facility. Each facility in the local system is given a unique identification number that is used on the computer maps. The second column gives the parcel location, and the third column provides the development level of the school facility. These facilities may be built or upgraded to one of three levels.

The fourth column gives the maintenance level for the school facilities. The department may change the maintenance level for any school facility. The maintenance level is the lowest level to which the value ratio will be allowed to decline before maintenance expenditures are incurred.

The fifth column is the value ratio for each school facility. The value ratio is a measure of the present value and effectiveness of the plant and equipment in relation to "brand new" plant and equipment. A value ratio of 80 means that the effective capacity of an educational facility is reduced to 80 percent of what it would be if the value ratio were 100.

The sixth, seventh and eighth columns show the number of students from each of the three classes that attend public schools in each of the districts. Columns nine and ten show the employment mix requests in terms of population units. The final column shows the School Use Index. It is the ratio of loading (demand) to effective capacity (supply) multiplied times 100. The formula for use index calculation is: Use Index $= C * V/S$. C = the school's capacity as determined by the mix of PH and PM teachers (see page **246**). V = the school's value ratio. S = the number of students attending the school. If the School Department for a particular school does not receive all of the employees it requests, the value of C (capacity) is adjusted to reflect that shortage (see page **238**). If the School Department did not hire all the population units it requested, a message is printed:

"7 middle income teacher requests not filled"

This would indicate that 7 PM's were not hired.

Undeveloped land:

This table shows the parcel location for undeveloped land owned by the School Department. It also shows the percent of the parcel owned by the department. The percent of a parcel required for a level one school facility is shown in the School Master Table (page **246**).

Contracts

The School Department purchases goods and services each round as part of the costs of operating and maintaining their school facilities. These purchases are made from BG and BS establishments in the local system if contracts to do so are submitted to the computer by the department. If no contracts to purchase locally supplied goods and services are made, then all needed purchases are made from the Outside system.

The contract table shows the type of good or service in column one. In the second column, the owner of the establishment supplying the good or service is indicated. The third column shows the parcel location of the supplier if it is a supplier within the local system.

The fourth column shows the percent of total purchases made from BG and BS suppliers. The fifth column shows the cost per BG and BS units being charged by the supplier. (The outside prices are fixed). The sixth column shows the number of BG and BS units purchased and the last column shows the total cost. This cost is derived by multiplying the cost per unit times the number of units purchased.

Adult education:

The School Department may operate a public adult education program if it wishes and can afford to pay the costs. The demand for public adult education is generated by the time allocations for free adult education by the Social Sector. The only cost to the School Department of supplying adult education services is the hiring of part-time teachers. Teachers may be hired in any desired mix from the PH and PM classes.

The first two columns show the number of part-time work units requested by the School Department from the PH and PM classes, respectively. Since the School Department competes in the labor market with all other employers of part-time workers, there is a chance that occasionally not all the teachers sought will actually be hired. Therefore, columns three and four show the part-time work units actually obtained.

The capacity of the adult education program is obtained by multiplying the high income part-time units actually hired times 15 and added that to the number of middle income part-time units multiplied by 10. Thus PH teachers provide 50 percent more capacity per work unit hired than PM teachers.

The used capacity is the number of leisure time units allocated to public adult education that were able to be served by the actual capacity of the adult education program. The unmet demand (if any) is the excess of the desired amount of time spent in public adult education by the population units of the local jurisdiction over the amount that was actually able to be spent given the capacity of the jurisdiction's adult education program.

At the bottom of the Adult Education Table, the local school age population in the jurisdiction is shown along with the number of these students who attended the public schools and the number who attended private schools. The population units whose children attended private schools had to pay the specified tuition per student as shown in the School Master Table (page **247**).

The salary offered PH and PM teachers is also listed at the end of the Adult Education Table. The same salary is offered to full time teachers for day classes and part-time teachers for adult education classes.

Boycotts

The Boycott Table shows three bits of information on the boycotting population units (team controlling, income class, and function which, for School boycotts, will always be work). When the School Department is the employer being boycotted, "SC" and the jurisdiction number appear under the third column heading entitled "owner".

New construction

The Construction Table shows projects that were completed at the beginning of the round and therefore were in operation for the entire round. Firm "0" indicates that an outside construction firm performed the construction. The site location is the parcel on which the school facility was constructed. The status will always appear as "Completed".

Old level is the previous development level for the school facility. A zero indicates that no school facility previously existed on that parcel. The new level is the present development level for the school facility after the construction. The price of construction is indicated along with the department-specified maintenance level (this applies to the entire structure) and the specified employment mix (this applies to the new total level).

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[illegible]

School department finances

Outstanding bonds -- This table shows the type (capital or current) of bond, the original principal, the number of rounds remaining to pay off the bond (all bonds start as 25- or 2-year bonds), the rate of interest being charged on the principal (determined by the state of the national bond market in the year the bond was floated), and the annual payment that must be made on the debt. Bond payments on a bond floated in round T being in round T+1. Thus a current bond incurred in Round 2 will start being paid off in Round 3.

```
****************************************************************************************
                                       TAXCITY     JURISDICTION 2          ROUND  2
                                       SCHOOL DEPARTMENT FINANCES
****************************************************************************************


                  CAPITAL                                             CURRENT

REVENUES                                             REVENUES

PREVIOUS CASH BALANCE              [illegible]       PREVIOUS CASH BALANCE            [illegible]
APPROPRIATIONS                              0        APPROPRIATIONS                   [illegible]
FEDERAL-STATE AID USED             [illegible]       FEDERAL-STATE AID USED           [illegible]
NEW BONDS                                   0        NEW BONDS                        [illegible]
MISCELLANEOUS                               0        MISCELLANEOUS                              0
                                  -----------                                        -----------
        TOTAL                      [illegible]                                        [illegible]


EXPENDITURES                                         EXPENDITURES

SCHOOL CONSTRUCTION                         0        GOODS AND SERVICES               [illegible]
LAND PURCHASES                     [illegible]       FULL-TIME SALARIES               [illegible]
MISCELLANEOUS                               0        MISCELLANEOUS                              0
                                                     BOND PAYMENTS                    [illegible]
                                                     ADULT EDUCATION                  [illegible]
                                  -----------                                        -----------
        TOTAL                      [illegible]                                        [illegible]


CURRENT BALANCE                    [illegible]       CURRENT BALANCE                  [illegible]



                          OUTSTANDING BONDS
                          -----------------

   TYPE             ORIGINAL        REMAINING      INTEREST          ANNUAL
                    PRINCIPAL         TERM           RATE            PAYMENT
  ------           ----------      ----------     ----------        --------

  CAPITAL          [illegible]     [illegible]    [illegible]      [illegible]
  CURRENT          [illegible]          1         [illegible]      [illegible]
  CURRENT          [illegible]     [illegible]    [illegible]      [illegible]
```

School map

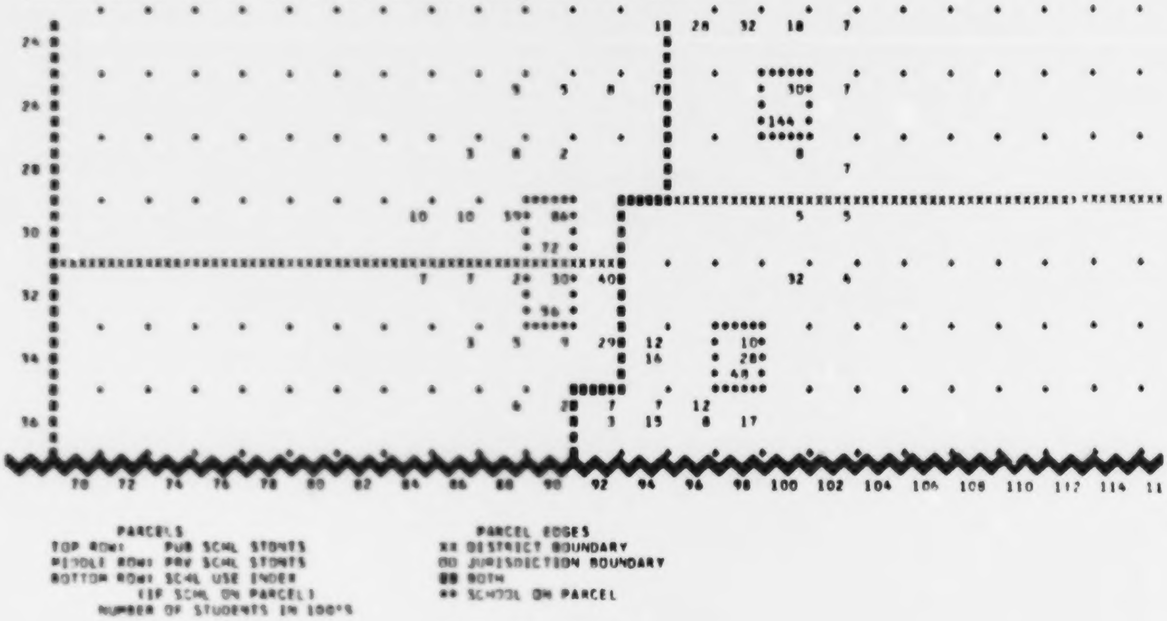
This map designates jurisdictional boundaries (000) and school district boundaries (xxx) for all school districts within each jurisdiction. A school district is a group of contiguous parcels that are within the service area of a school facility. Therefore, every school facility has an associated school district. There may be parcels of land that are not served by a public school district. School-aged children on these parcels are forced to attend private schools.

The information contained on a parcel of occupied residences shows the number of students attending the local public school (top line) and the number of students attending private school (middle line). Both of these student figures are expressed in hundreds of students. The *School Use Index* is shown on those parcels on which a school facility is located, as indicated on the map by surrounding asterisks (***).

Students from high and middle income families will attend the local public schools only if a certain number of school quality criteria are met. Consult the *School Master Table* (page **247**) for the specific criteria.

The *School Use Index* is dependent upon the number of students attending the school district and the capacity of the school district given the level and value ratio of the school facility and the mix of teachers. As this index rises above 100, the quality of public school services declines. The *School Use Index* affects the neighborhood index (neighborhood dissatisfaction) which in turn affects migration and housing selection.

School district boundaries may be altered by the School Department in an effort to improve the supply-demand balance, serve areas previously not served, and/or change the social class mix of the students attending the public schools.


24
26
28
30
32
34
36
18 28 32 18 7
5 5 8 78 30 7
144
3 8 2 8 7
10 10 59 86 5 5
72
7 7 24 30 40 32 4
96
3 5 9 29 12 10
16 28
48
6 28 7 7 12
3 15 8 17
70 72 74 76 78 80 82 84 86 88 90 92 94 96 98 100 102 104 106 108 110 112 114 11
PARCELS
TOP ROW: PUB SCHL STDNTS
MIDDLE ROW: PRV SCHL STDNTS
BOTTOM ROW: SCHL USE INDEX
(IF SCHL ON PARCEL)
NUMBER OF STUDENTS IN 100'S
PARCEL EDGES
XX DISTRICT BOUNDARY
OO JURISDICTION BOUNDARY
BB BOTH
** SCHOOL ON PARCEL

School department decisions

The three categories of decisions made by the School Department are those that are jurisdiction-wide in scope, those that pertain to individual school facilities and districts, and those that are capital land and construction decisions.

Jurisdiction-wide:

- Change salary levels
- Award BG and BS contracts
- Transfer cash
- Offer adult education

Individual school facilities:

- Change district boundaries
- Change maintenance level
- Change employment requests
- **Request Federal/State aid for construction**

Capital:

- Acquire and sell land
- Construct or demolish school facilities

The School Department does not need to make any decisions if it does not wish to do so. If no decisions are made, it is assumed that salaries, contracts, district boundaries, maintenance levels, and employment requests remain at their present values. If no decisions are made, there will be no cash transfers, land transfers, constructions, or demolitions.

The School Department must be aware of the local system constraints on its decision-making. Capital expenditures may not be made unless there are sufficient funds in the capital account. New appropriations from the Chairman may increase the amount of these capital funds.

Input format

The School Department decision-makers use a standardized input form when making decisions to be processed by the computer. The standard message format is:

$CODE/ = dm/a, b, c, d, ...

$CODE stands for the type of decision code. The School Department has the option to make decisions that use the following decision codes:

$OTHER (adult education programs, salaries)

$CVPT (contracts, maintenance, employment)

$CASH (transfer cash)

$REDIST (redistrict)

$TU (land transfer)

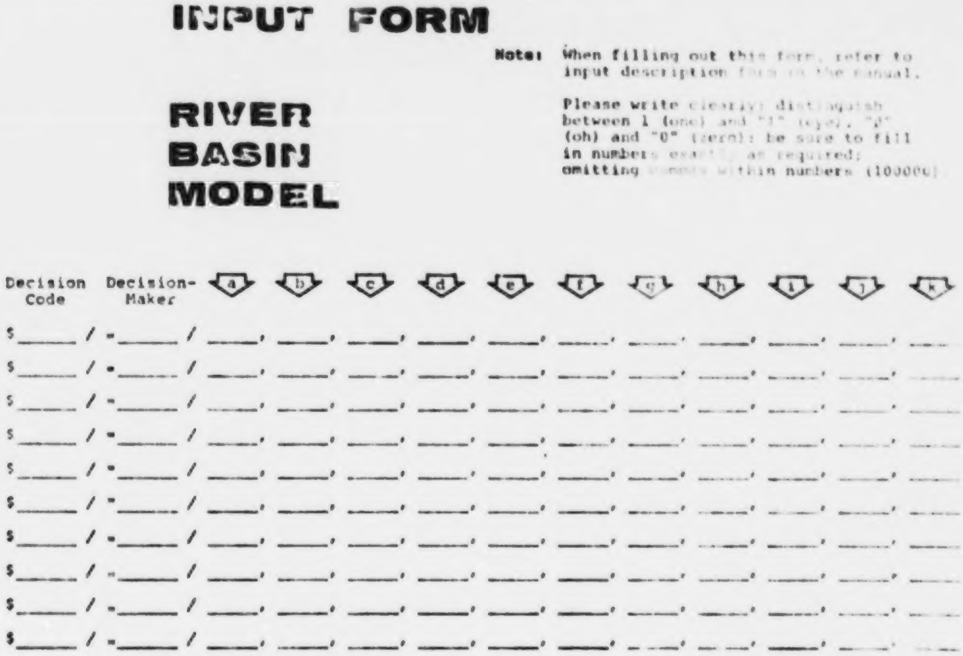
$OUBLD (construct or demolish)

$FSA (request Federal-State aid)

"=*dm*" is the decision-maker, which for the School Department is *SC1*, *SC2*, or *SC3*, depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the SC decision-maker code, even if there is only one active jurisdiction.

The columns "*a*", "*b*", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).



INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "O" (oh) and "0" (zero); be sure to fill in numbers exactly as required; omitting commas within numbers (100000).

RIVER
BASIN
MODEL

Decision Code / Decision-Maker / a, b, c, d, e, f, g, h, i, j, k

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____

$_____ / =_____ / _____, _____, _____, _____, _____, _____, _____, _____, _____, _____, _____ School department: Input explanation form

Type of decision	Code	Decision Maker	a	b	c	d	e	f	g
Purchase or bid on land	SPU	SC1, SC2, or SC3	location	price (in $1000's)	seller (economic decision-maker or department)	percent of parcel (0 if all)			
Change employment	SCVPT	SC1, SC2, or SC3	E	location	new number of PW units working there	new number of PW units working there			
Change maintenance level	SCVPT	SC1, SC2, or SC3	M	location	new maintenance level				
Change district boundaries	SREDIST	SC1, SC2, or SC3	location of school	list of new parcels in district in parentheses*					
Transfer cash	SCASH	SC1, SC2, or SC3	C	receiver (economic or social decision-maker or department and jurisdiction	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT; if social receiving, class receiving (H, M, or L); if department receiving, to CAPital or CURrent account	0	if social receiving, location receiving
Award BG or BS contracts	SCVPT	SC1, SC2, or SC3	C	location of BG or BS establishment	percent of total BG or BS purchase to be bought there	new priority	displaced priority	owner of BG or BS establishment	

*Parcels can be listed within parentheses by specifying upper left and lower right hand corners separated by "-". Example:

SREDIST/= SC1/9434, (9232 - 10040)

Type of decision	Code	Decision maker	a	b	c	d	e	f	g
Request adult education teachers	SOTHER	SC1, SC2, or SC3	EA	number of middle-income time units requested	number of high-income time units requested				
Change salaries	SOTHER	SC1, SC2, or SC3	S	salary to middle income workers (in $100's)	salary to high income worker (in $100's)				
			a	b	c	d	e	f	g
Construct, upgrade or demolish a school by the "Outside System"	SOUBLD	SC1, SC2, or SC3	site location	SC	old level (0, if new building)	new level	new maintenance level	number of PM's working	number of PH's working there
Request Federal-state aid	**SFSA**	**SC1, SC2, or SC3**	**New level for which aid is requested**	**Site location**					

Sample decisions for the school department

Note that the jurisdiction number must always be given even if only a single jurisdiction exists.

Jurisdiction-wide decisions:

Change salary levels: The School Department in Jurisdiction 2 wishes to change its salaries for PM's to $5200. Note that no dollar signs need to be placed on the dollar amounts and that the old salary for the PH's must also be input. The decision is to change salaries, and if nothing had been placed in the column for PH salary, the computer would read the blanks as zeros and the new PM salary would be put to the minimum amount.

Decision Code **Decision-Maker** a b c d e

$ OTHER / = SC2 / S , 52 , 100 , ____ , ____ ,

Award BG or BS contracts: Case 1: The School Department in Jurisdiction 3 wishes to make a BG contract so that all its purchases will be made from a single local supplier (BS at 9830). Presently, all the purchases are being made from the Outside system.

$ CVPT / = SC3 / C , 9830 , 100 , ____ ,

Case 2: The School Department in Jurisdiction 1 wishes to split its BS purchases between two local suppliers in such a way that one gets 60 percent of the School Department business (BS at 10012) and the other gets 40 percent (BS at 10636). Previously, a third BS establishment at 11040 had supplied all of the BS services for the School Department. Its contract must be negated.

$ CVPT / = SC1 / C , 10012 , 60 , ____ ,
$ CVPT / = SC1 / C , 10636 , 40 , ____ ,
$ CVPT / = SC1 / C , 11040 , 0 , ____ ,

A department in a jurisdiction may not have more than three contracts for BG or more than three contracts for BS purchases.

Transfer cash: Case 1: The School Department in Jurisdiction 2 wishes to transfer $1,000,000 from its current account to its capital account.

$ CASH / = SC2 / C , SC2 , 1000000, CUR , CAP ;

Case 2: The same department wishes to transfer $525,000 to Economic Team B from its current account.

$ CASH / = SC2 / C , B , 525000, CUR , PVT,

Adult education: The School Department in Jurisdiction 2 decides to hire 250 time units of PM teachers and 300 time units of PH teachers.

$ OTHER / = SC2 / EA , 250 , 300 , ____ , ____ ,

Operational decisions for specific school facilities

Change district boundaries: The decision to change the boundaries for one school facility does not require that the boundaries for other school facilities be changed unless contiguity is involved. If the School Department makes substantive error in any of its redistricting decisions in a round, all the redistricting decisions are rejected. The School Department in Jurisdiction 1 decides to add a previously unserved parcel (9048) to the School district served by the school on parcel 9036. It also wants to add parcels 9840, 9842, 10040, and 10042. These four parcels form a "block input".

$ REDIST / = SC1 / 9036, (9048, 9840 > 10042) ____ ,

Change maintenance level: The School Department in Jurisdiction 2 decides to raise the maintenance level for its school facility at 7420 to 80, and to lower the maintenance level for its school facility at 7630 to 85.

$ CVPT / = SC2 / M , 7420, 80 / M , 7630, 85 , *Change employment requests:* The School Department in Jurisdiction 2 decides to change the labor mix for the school facility at 7420 to 3 PM and 4 PM and to change the mix at the second level school at 7630 to 7 PM and 8 PM. **Example shows multiple coding.** ▽

Decision Code | Decision-Maker | a | b | c | d | e | f | g | h

$ CVPT / = SC2 / E , 7420, 3 , 4 / E , 7630, 7 , 8

△

Capital decisions

Acquire or sell land: Case 1: The School Department in Jurisdiction 1 purchases 12 percent of parcel 7842 from Economic Team B for $570,000.

$ PU / = SC1 / 7842, 570, B , 12 , ____,

Case 2: The School Department in Jurisdiction 2 attempts to purchase 24 percent of parcel 10032 from Outside System owners with an unsolicited bid of $1,500,000.

$ PU / = SC2 / 10032, 1500, OU , 24 , ____,

Case 3: The School Department in Jurisdiction 3 gives 12 percent of parcel 8436 to the Planning and Zoning Department in its jurisdiction. (Note that the receiver is designated as the decision-maker.)

$ PU / = PZ3 / 8436, 0 , SC3, 12 , ____,

Construct a school facility: Case 1: The School Department in Jurisdiction 1 wishes to build a **school facility** on parcel 8832, have a maintenance level of 90, and hire 3 PM's and 3 PM's to work there.

$ ØUBLD / = SC1 / 8832, SC , 0 , 1 , 90 , 3 , 3 ,

Case 2: The department also decides to upgrade the school facility on parcel 10020 from a level 1 to a level 3 and make the new maintenance level for the entire facility be 85 and hire 12 PM's and 15 PM's .

$ ØUBLD / = SC1 / 10020, SC , 1 , 3 , 85 , 12 , 15 ,

Case 3: Because of the demolition of several residential structures within its boundaries, the school facility at 8640 has been slated for a reduction in capacity by the School Department in Jurisdiction 2. It is decided that the school should be reduced from a level 2 to a level 1 and the maintenance reduced to 70 and employment cut to 3 PM and 2 PM.

$ ØUBLD / = SC2 / 8640, SC , 2 , 1 , 70 , 3 , 2 ,

MASTER SHEET FOR THE SCHOOL DEPARTMENT

General Characteristics

	SC1
Construction Cost	$27,000,000
Land Requirements	6%
Annual Depreciation Rate	2%
BG and BS Requirements	
For 1% Maintenance	
BG	2 units
BS	.7 units
For Normal Operation	
BG	8 units
BS	3 units
Federal-State Aid	
Capital	$1 for every local $1
Current (automatic)	$225 per student

Design Capacity (in Students) as a Function of the Number and Class of Population Units Assigned to Teach There

		PM						
		0	1	2	3	4	5	6
	0		2,520	4,140	6,840	9,900	12,240	13,140
	1	3,600	5,910	8,460	11,200	13,320	15,300	17,100
	2	7,200	9,900	12,600	15,500	17,460	19,440	21,240
PH	3	10,800	14,040	16,920	20,000*	21,960	23,760	25,560
	4	13,140	17,460	21,060	23,400	25,200	27,000	28,620
	5	17,100	20,700	23,400	26,640	28,440	30,000	31,500
	6	19,800	23,850	26,820	29,880	31,320	32,850	34,200

*The least cost design capacity of an SC1

Master Sheet for the School Department -- Cont'd

Population Unit Characteristics

Characteristics	PH	PM	PL
Number of students	130	140	100
Criteria for Refusal Attend Public Schools			
Value Ratio (Min.)	80	60	None
Student-Teacher Ratio (Maximum)	18:1	22:1	None
Ratio of High to Middle Teachers (Minimum)	1:1	3:4	None
Cost of Private Education (for students)	$39,000	$24,500	$12,500

Capital Federal-State Aid

1st Request: 60% chance of acceptance

2nd Request: 40% chance of acceptance

3rd Request: 30% chance of acceptance

ADULT EDUCATION

School Demand	School Supply
Each time unit allocated to public adult education is a unit of demand.	Classes held in public school facilities - only additional cost is for part-time teachers.

One Unit of Time by Pl Hired	Provides Units of Adult Education
PH	15
PM	10

Highway department

The local Highway Department has influence over transportation accessibility within the local system and can alter this accessibility in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials, the local citizenry and the business community.

The Highway Department has the responsibility for two types of transportation decision-making: building and maintaining the highway system within the jurisdiction and building transportation terminals to be used by local businesses as places to ship and receive finished products to and from national markets.

The local highway system is used by all auto and bus peak-hour to-work commuters and by all persons and businesses for their local commercial activities. Roads of several capacities may be constructed. These roads become congested at peak hours when more vehicles use them than they were designed to handle. Congestion raises the time and dollar costs of population units travelling over the congested roads.

Terminals are located at intersections of roads, and they may be of several capacity levels. Both terminals and roads require land from the parcels they abut.

Highway department output

The Highway Department controls the construction of roads and terminals and the maintenance of roads. Roads are located between parcels and consume land from both adjoining parcels; a terminal is located at corners of parcels (intersection) and consumes land from the four parcels which border the intersection.

There are three types of highways: HY1, HY2, HY3. An HY3 is the largest road, and the cheapest for users to travel on. The type of road determines its design capacity in terms of the number of vehicles which it can handle without congestion when it is in the best condition. Highways depreciate as a function of use. The value ratio of a segment of highway is the percent of its design capacity which it can actually handle. The lower the value ratio of a road, the less its effective capacity.

Road congestion occurs when there are more vehicles using a road segment than can be handled by the road. Congestion is recorded only during peak-hour travel. When congestion occurs, it takes additional time for population units to travel along the congested road segment. The amount of additional time is directly proportional to the amount of congestion on the highway. For example, if the peak-hour congestion is 110%, the time to travel a road is 10% greater than otherwise. Time consumed in transportation to and from work affects the allocation of leisure time in the social sector.

Terminals are used by heavy industry, light industry, and business goods. Industries use terminals to ship output to national demanders and BG receives goods from national suppliers.

Highway Department finances

The Highway Department receives income to its current and capital accounts from various sources. These include appropriations, Federal-State aid, bonds, and miscellaneous income. Appropriations are distributed to the current and/or capital accounts of the department by the Chairman. The department must request Federal-State aid for road construction from the computer and if it is granted, the aid can be used only for the approved project. The department does not receive the aid until the approved project is performed. Current bonds are automatically floated by the computer if the current expenditures of the department exceed its current revenue. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for the department by the Chairman subject to a referendum by the social sector. Capital bonds have a duration of 25 years and the interest rate is set by the computer. Miscellaneous income includes such items as cash transfers to the capital or current account of the department, and income from the sale of land (capital account only). The Highway Department spends money on road maintenance, bond payments, miscellaneous, construction and land purchase.

The Highway Department must purchase business goods (BG) and business services (BS) for the maintenance and/or renovation of its roads. BG and BS are purchased by the Highway Department at fixed costs from the Outside system. Bond payments include payments on interest and principal of outstanding capital and current bonds floated by the department. Miscellaneous expenditures involve cash transfers from the capital or current accounts of the department to an economic, social, or governmental decision-maker, or from one account to another account.

Each outstanding bond is listed on the bond table, one row per bond. The first item is the type of bond, capital or current. A capital bond has a term of 25 years; a current bond has a term of 2 years. The original principal, remaining term, interest rate, and annual payment are given. The remaining term is the number of rounds after the current round in which the department must make the annual payment. The annual payment is calculated by the computer to pay off the bond in equal installments each year, and the payment is made automatically by the computer from the department's current account.

Below the outstanding bond table is a table which shows the maintenance level, number of segments, and average depreciation of each road type. The Highway Department specifies a road maintenance level by road type, not for each individual road segment.

The next table shows the location of road segments at each value ratio (depreciated value before maintenance). Below a road's coordinates is its congestion, the amount which the road is used in peak-hour transportation in excess of its effective capacity. If a road showed a congestion of 30, it would have 30% more use than it could effectively handle.

The detail on terminals shows the location, level, design capacity (in terminal units), and terminal units used there.

The location and amount of land (in percent of a parcel) is shown for all undeveloped land owned by the department.

```
**********************************************************************************************************
                                           [illegible]
                                 HIGHWAY DEPARTMENT FINANCES                               JURISDICTION 1
**********************************************************************************************************
F I N A N C I A L   R E P O R T
-------------------------------

                         CAPITAL                                                  CURRENT
                         -------                                                  -------


      PREVIOUS BALANCE            $          0.                PREVIOUS BALANCE            $      5229.


      REVENUES                                                 REVENUES
           APPROPRIATIONS         $          0.                     APPROPRIATIONS         $   1000000.
           FEDERAL/STATE AID                 0.
           NEW BONDING                23000000.                     NEW BONDING                 760000.
           MISCELLANEOUS                     0.                     MISCELLANEOUS                    0.
      TOTAL REVENUE               $   23000000.                TOTAL REVENUE               $   1760000.


      EXPENDITURES                                             EXPENDITURES
           ROAD CONSTRUCTION      $          0.                     ROAD MAINTENANCE       $    908923.
           TERMINAL CONSTRUCTION             0.                     BOND PAYMENTS               847455.
           LAND PURCHASE                     0.
           MISCELLANEOUS              23000000.                     MISCELLANEOUS                    0.
      TOTAL EXPENDITURES          $   23000000.                TOTAL EXPENDITURES          $   1756378.


      NEW BALANCE               $            0.                NEW BALANCE               $        8851.


                        OUTSTANDING BONDS
                        -----------------

     TYPE             ORIGINAL       REMAINING      INTEREST          ANNUAL
                      PRINCIPAL        TERM           RATE            PAYMENT
     ----             ---------      ---------      --------          -------

   CAPITAL             5000000.        12             5.0             556766.
   CURRENT              960000.         1             3.2             697283.
   CAPITAL            23000000.        25             3.1            1161927.
   CURRENT              760000.         2             5.7             401223.
M A I N T E N A N C E
---------------------

      ROAD        MAINTENANCE          TOTAL          AVERAGE DEPRECIATION
      TYPE           LEVEL             MILES          BEFORE MAINTENANCE              COST
      ----        -----------          -----          --------------------        ----------


        1             93.0              25.0                 0.2                $      17778.
        2             80.3              10.0                 0.7                $     331113.
        3             92.0              27.5                 0.8                $     560032.
R O A D   C O N D I T I O N S   B E F O R E   M A I N T E N A N C E
-------------------------------------------------------------------

      VALUE RATIO   ROADS
                 .
      ******************************************************************************************************
                 .
       95 - 93 .  9516  9514  9522  3024  9321  9224  9921  8827  8726  9327  9227  9128  9130  7031  7231
                 .     0     0     0     0     0     0     0     0     2     8     0     8     2     0     0
                 .
                 .  7031  7531  7431  8231  8231  8831  [illegible]  8125
                 .     0     0     0     0     0     1     5     9
                 .
                 .
      ******************************************************************************************************
                 .
       93 - 85 .  9526  9527  9231  3931  8732  9331  8831  9334  9331  8730
                 .    42    11    67    17    28    69    33    26    24    17
                 .
                 .
      ******************************************************************************************************

      THERE ARE NO ROADS IN THIS JURISDICTION WITH VALUE RATIOS BELOW 85
T E R M I N A L S
-----------------

UNDEVELOPED LAND
----------------
      LOCATION  AMOUNT     LOCATION  AMOUNT     LOCATION  AMOUNT     LOCATION  AMOUNT     LOCATION  AMOUNT
      --------  ------     --------  ------     --------  ------     --------  ------     --------  ------
        86-22      5         86-22      5         93-25      5         92-23      5         94-22      5
        86-24      5         89-24      5         93-24      5         92-24      5         94-24      5


FEDERAL/STATE AID AVAILABLE FOR HIGHWAY CONSTRUCTION : NONE
-----------------------------------------------------------
```

Last, a table shows the locations of roads for which Federal-State aid has been granted but which have yet to be constructed. The road type for which the aid has been approved is also shown.

Highway Department Construction Table

This output shows the site location, type of construction (road or terminal), and old and new level of development of all construction or demolition decisions input by the department and accepted by the computer during the previous round.

```
*****************************************************************************************
                 Twocity
                 Highway Department Construction Table    Jurisdiction 1       Round 8
*****************************************************************************************
Construction   Site                     Old        New      Agreed            Federal/State Aid
 Firm        Location      Status      Level      Level      Price               Amount Used
**********   *********    *******     ******     ******    *******          ******************

   0           8724      COMPLETED       0          2      4000000                2000000

   0           8726      COMPLETED       0          2      4000000                2000000

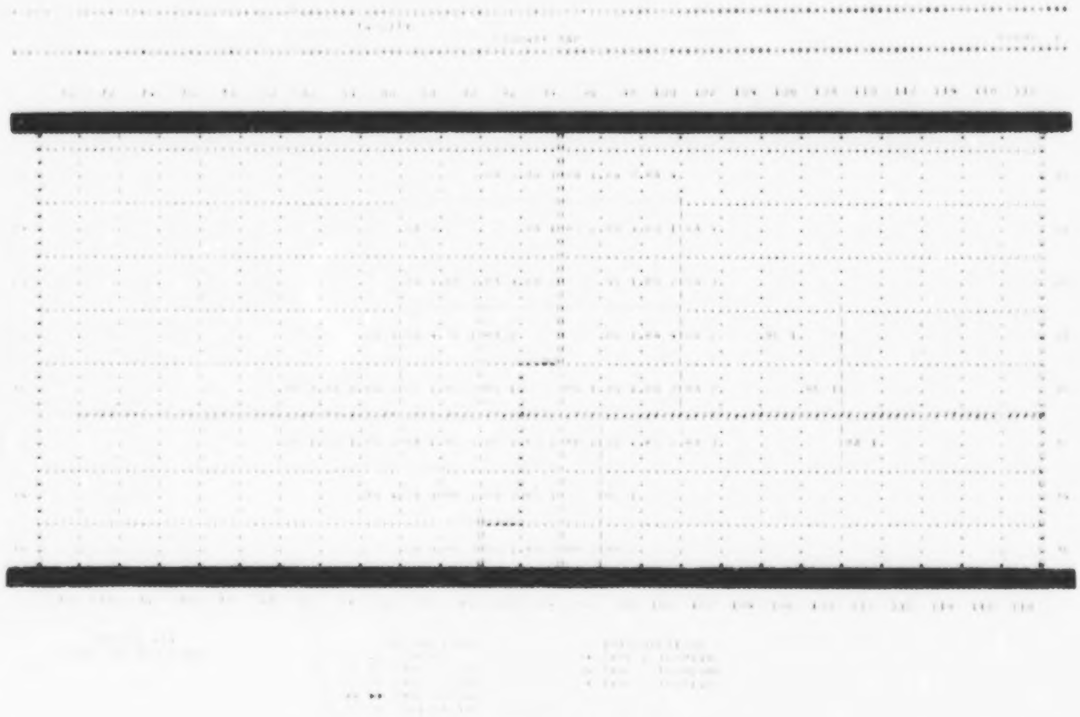
   0           7817      COMPLETED       0          2      4000000                2000000
```

Highway map

This map designates the location and level (capacity) of roads and terminals. Roads may be located along the sides of the parcels of land, and are built at one of three operating levels (1 through 3, with 3 being the largest capacity road). Road locations are identified by a coordinate pair that consists of an even and an odd number. For example, 7011 is the east-west roadbed at the upper left portion of the map and 6912 is the north-south roadbed at the upper left portion of the map. [Roads may not be built along the extreme right boundary (line 119) or along the extreme bottom boundary (line 61) of the map.]

Terminals may be built at one of three service levels (with level 3 being the largest capacity). Terminals are located at the intersections of roads or roadbeds. Business activities that use terminals are assigned to specific terminal locations taking into account accessibility and terminal capacity.

When constructing a road, the Highway Department must buy adequate land (refer to the Highway Department Master Tables, page 288) from the parcels on both sides of the roadbed. In constructing a terminal the department must buy land from all four parcels adjoining the intersection where the terminal is to be located.



Summary of Highway Department decisions

The decisions which the Highway Department can make fall into two categories: those which are jurisdiction-wide in scope and those that pertain to individual locations.

Jurisdiction-wide:

- Transfer cash
- Change maintenance level of a road type

Individual locations:

- Buy or sell land
- Construct or demolish roads or terminals
- Request Federal-state aid for road construction

The department can make as many of each of these decisions as it wishes. The department can also choose to make no decisions. If no decisions are made, no cash or land is transferred and no new Federal-State aid is granted. Roads and terminals remain the same as in previous rounds, and roads are maintained at the previous maintenance levels.

Input format

Highway Department decision-makers use a standardized input form when making decisions that must be processed by the computer. The standard message format is:

&CODE/ = dm/a, b, c, d, . . .

&CODE stands for the type of decision code. The Highway Department has the option to make decisions that use the following decision codes:

&OTHER (maintenance)
&CASH (transfer cash)
[illegible] (land transfer)
&BUILD (construct or demolish)
&FSA (request Federal-State aid)

"*=dm*" is the decision-maker, which for the Highway Department is *HY1*, *HY2*, or *HY3*, depending upon the appropriate jurisdiction number. A jurisdiction number must always follow the HY decision-maker code even if there is only one active jurisdiction.

The columns "*a*", "*b*", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

Highway Department: Input explanation form

Type of decision	Code	Decision Maker	a	b	c	d	e
Purchase or bid on land	SPU	HY1, HY2, or HY3	location	price (in $1000's)	seller economic decision-maker or department and jurisdiction or OU)	percent of parcel (0 if all)	
Change maintenance level	SOTHER	HY1, HY2, or HY3	M	new maintenance level	type of road (1, 2, or 3)		
Construct, upgrade or demolish a road or terminal by the "Outside system"	SOUBLD	HY1, HY2, or HY3	site location	HY if road TM if terminal	old level (0 if new road or terminal)	new level (0 if demolition)	if on jurisdiction boundary, jurisdiction numbers, separated by commas
Request federal-state aid	SFSA	HY1, HY2, or HY3	new level for which aid requested (1, 2, or 3)	location of road for which aid is requested			
Transfer cash	SCASH	HY1, HY2, or HY3	C	receiver (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker is receiving, PVT; if social receiving, class receiving (H, M, or L); if department is receiving, to CAPital or CURrent account *

	f	g
*	0	If social receiving, location receiving

Highway Department sample decisions

(The input format is shown below each example. Note that the jurisdiction number must always be given even if only a single jurisdiction exists.)

Jurisdiction-wide decisions:

Transfer Cash: Case 1: The Highway Department in Jurisdiction 3 wishes to transfer $6,000,000 from its current account to its capital account.

Decision Code **Decision-Maker** a b c d e f g

$CASH / = HY3 / C , HY3 ,6000000, CUR , CAP , ____ , ____

Case 2: The same department wishes to give the low-income residents controlled by BB on parcel 9832 a total of $80,000 (to be divided among the PI's) from its capital account for agreeing to allow the new superhighway to replace parkland on their residence parcel.

$CASH / = HY3 / C , B , 80000 , CAP , L , 0 , 9832 ,

Change road maintenance levels: The Highway Department in Jurisdiction 1 decides to maintain all of the Type 3 roads in the jurisdiction at a value ratio of 98.

$OTHER / = HY1 / M , 98 , 3 , ____ , ____ ,

Location specific decisions

Buy or sell land: Case 1: The Highway Department in Jurisdiction 3 wishes to build a new road at 108-31, and it has agreed to purchase 8% of 108-30 for $32,000 from its economic owner, team D, and 8% of 108-32 for $10,000 from the Utility Department which owns some undeveloped land there.

$ PU / = HY3 / 10830, 32, D, 8, ____;
$ PU / = HY3 / 10832, 10, UT3, 8, ____.

Case 2: The same Highway Department gives the Utility Department 4% of 112-28 for free as part of the same deal. (Note that the new owner is designated as the decision-maker.)

$ PU / = UT3 / 11228, 0, HY3, 4, ____.

Construction or demolition/upgrade and downgrade: Case 1: The same Highway Department builds a Type 1 road at 108-31, for which it has just obtained land.

$ 0UBLD / = HY3 / 10831, HY, 0, 1, ____.

Case 2: The Highway Department in Jurisdiction 1 increases the size of a terminal at 83-29 from level 2 to level 3 near an expanding community. It already owns sufficient land at 82-28, 84-28, 82-30, and 84-30 for the construction.

$ 0UBLD / = HY1 / 8329, TM, 2, 3, ____.

[illegible] The Highway Department in Jurisdiction 2 requests aid for a Type 2 road at 9833, 9633, 9433, and 9233. This stretch of road will have no gaps or turns, so it can be "block input".

$ FSA / = HY2 / 2, (9833>9233), ____, ____.

MASTER TABLE FOR THE HIGHWAY DEPARTMENT
(Characteristics for Level One Unless Stated Otherwise)

Facility	Highways	Terminals
LOCATION REQUIREMENTS	HY	TM
Percent of Parcel	(from both sides)	(from 4 corners)
Level 1	8	12
Level 2	12	16
Level 3	16	20
CONSTRUCTION COSTS (Millions of Dollars)	2	14
DEPRECIATION		
Due to Use	5.0 Z a)	NA
ROAD MAINTENANCE		
Purchases per 1% Maintenance	$20,000/segment	NA
CAPACITY MEASURES		
Design Capacity (standardized units)	500/segment	10,000
Consumption by Users (standardized units)		
PL	10	
BUS (level 1)	50	
BG		1 per CU sold
FL,NL,EL,TA		1000
MF,TE		2000
FO,PA,CR		3000
MP		6000
SG		10000

FEDERAL-STATE AID FOR CAPITAL CONSTRUCTION	Matching Federal	Matching Local	Probability of Receiving Aid
ROAD TYPE			
Level 1	$1	$9	80%
Level 2	$1	$1	50%
Level 3	$2	$1	30%

Limit on the number of road segments requested by a jurisdiction is 5.

NOTE: a) Z = highway units used/effective capacity
and,
effective capacity is the design capacity times the value ratio expressed as a percent.

OPERATION OF FEDERAL-STATE AID

Highways	Type of Road	Matching Federal	Matching Local		
Capital Aid	I	$1	$9	5	80%
	II	$1	$1	road	50%
	III	$2	$1	segments	30%

Bus and Rail Companies

The local Bus and Rail Companies influence the transportation accessibilities within the local system. They can alter these accessibilities in such a way as to satisfy self-established goals and/or to respond to pressures brought on it by elected officials and the local citizenry and business community.

Once the players comprising the Bus and Rail Companies have become familiar with the model in general, the particular city being represented, and the workings of the local transportation subsystem they will be able to bring their own imagination and initiative to bear on the operation of the Bus and Rail Companies.

The Bus and Rail Companies can provide non-automobile transportation service to the population living in the simulated region. Bus and rail are used for the trip to full-time work only; they are not optional modes in either the part-time employment or the commercial allocation process.

Workers are assigned routes and modes of travel to work by the computer program. A social decision-maker assigns a dollar value for a time unit spent travelling to work by the people in his control. The program assigns workers to their cheapest modes and routes of travel, cheapest being least actual dollar cost plus the time cost (as set by the dollar value of a time unit travelling). The number of time units which are required to travel on a mode are a function of fixed time requirements and the amount of congestion on the mode. The dollar cost of auto is fixed, and the dollar cost to a worker to use bus or rail are set by the Bus and Rail Companies. Auto tends to have the highest dollar cost to travel, rail tends to have the least time cost, and bus tends to fall somewhere in between. Auto can travel wherever there are roads, bus can travel wherever there are roads and bus routes, and rail can travel only where there are rail lines.

Bus and Rail Company reports

Although the Bus and Rapid Rail Companies are separate quasi-private departments, they will be treated in the same section due to the similarities between the two. Neither is limited to a single jurisdiction; both have interjurisdictional authority.

The Bus and Rapid Rail Companies own rolling stock with three possible levels of service (1, 2, and 3). Level of service indicates the actual number of buses or railroad cars which may serve a particular route.

The number of passengers (capacity that can be effectively served by a rail or bus route) is determined by its level of service. The design capacity of a bus or rail route is not necessarily its effective capacity. Effective capacity is determined by multiplying the value ratio of equipment, divided by 100, times the design capacity. Effective capacity can be further reduced by employment. If the Bus or Rapid Rail Company receives only 75% of the employees which it requested, the actual effective capacity of that route is 75% of what it would be if the entire employment needs had been met.

It must be noted, however, that effective capacity does not refer to the number of people who actually use a bus or rail. A bus or rail route may serve fewer or more people than its effective capacity. For example, the bus service with an effective capacity of 5,000 may actually be used by 6,000 people. In such a case the computer has decided that for these people, despite the overcrowding, it is still cheaper in terms of time and money to take a bus rather than another mode of transportation.

The Bus and Rapid Rail Companies do not buy individual pieces of rolling stock. Rather, they purchase units of equipment for each mile of service. Forty units of equipment are required to operate a bus (level of service = 1) for one segment and 80 units of equipment are required to operate a rail (level of service = 1) for one mile. Equipment is purchased from the Outside System.

Bus and rail equipment which is used depreciates at an average rate each round. Goods and services for maintenance are automatically purchased from the Outside System (i.e., the computer) at fixed prices.

The Bus and Rail Companies employ workers from middle income population units (PM) only. They obtain their workers through the usual employment process handled by the computer. One PM (160 workers) supplies 1,000 units of labor and 50 units of labor are required to operate a bus (level of service = 1) or rail (level of service = 1) for one mile. One PM of workers therefore serves 20 miles of a BUS1 or RAIL1.

Passengers are assigned to travel to work by bus and/or rail by the computer. The basis upon which a population unit may or may not be assigned to bus or rail transportation is the dollar value of their time. This value is assigned by social decision-makers.

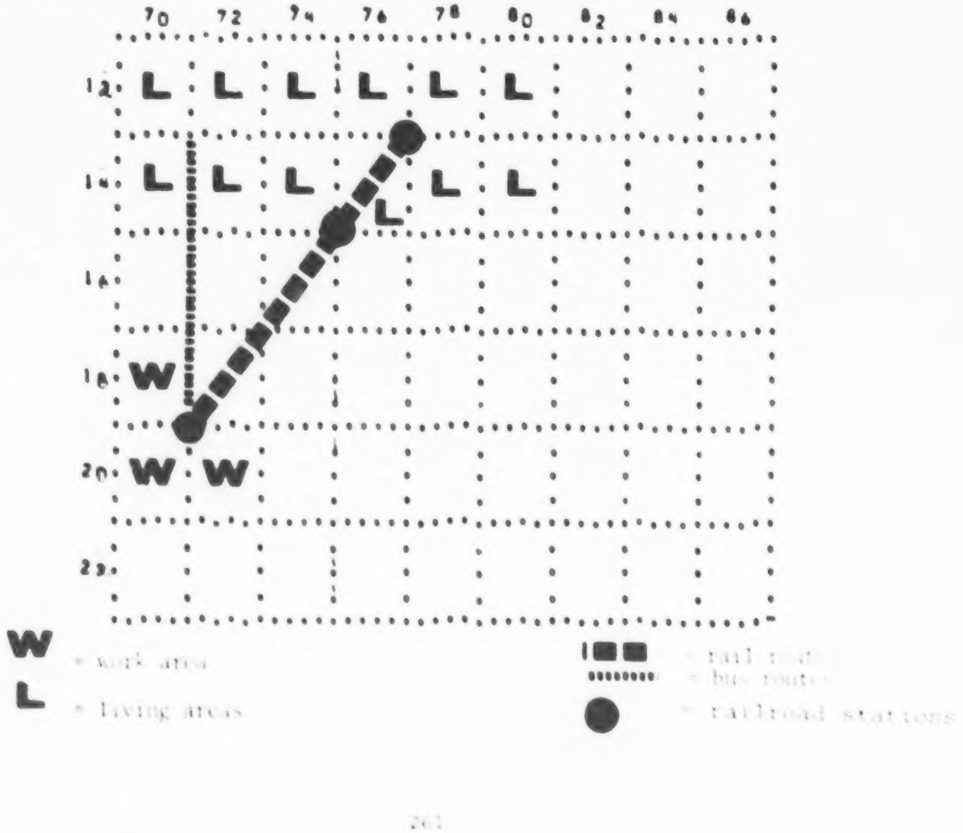
Those population units with the lowest dollar value of time will take the cheapest but possibly the longest route of transportation to work. Those population units with a high dollar value of time will take a more expensive but quicker mode of transportation to work.

The following example will demonstrate how the computer considers the dollar value of time. Let us say the transportation costs of a population unit are $150 per year to get to work by bus and $320 to get to work by auto. It also requires an extra 4 time units to travel by bus instead of auto. If the dollar value of time for that population unit was set at $40, it would cost them $150 plus 4 units times $40 (dollar value) or $310 to get to work by bus. To take auto, it costs $320 (no extra time units consumed). Therefore, the computer would assign the population the bus mode to travel to work (i.e., $310 < $320).

In the same case, suppese the dollar value of time were set to $50. Then, the total bus costs would be $150 plus 4 time units times $50 (dollar value) or $350. Auto would cost only $320. Therefore, the computer would assign these population units the auto mode to work (i.e., $320 < $350).

Once a PI takes bus or rail on the trip to work, it can no longer consider auto to be a modal option during that trip.

The Bus Company must therefore specify routes only on existing highways, while the Rail Department can have routes wherever they build tracks, including on the diagonal across parcels and either overground or underground. Routes must begin and end at intersections. Further, although bus and rail transport workers to and from their place of employment, the direction of the route is specified in order to meet residence to work demands. For example, assume that people live in the parcels above the line 15 and that most employment locations are at parcels 7018, 7020, and 7220.



The routes that should be specified are the morning routes that bring people to work. In this instance they are 7113 to 7119 (for bus) and 7713 to 7119 (for rail). A bus stops at every intersection but a rail will stop only where there are stations and there can only be stations at intersections. In the example above therefore, the rail has three stops: 7713, 7515, and 7119. In planning routes decision-makers for bus and rail will often discover that a key element involves the proximity of stops to parcels where the greatest number of people work and/or live.

Although buses do not require land (they operate on highways), surface rail tracks require land (on either side) per mile. A diagonal track requires land from each parcel which it crosses. All land must be purchased by the company prior to the construction of tracks. Underground rail tracks do not require land.

Financial report

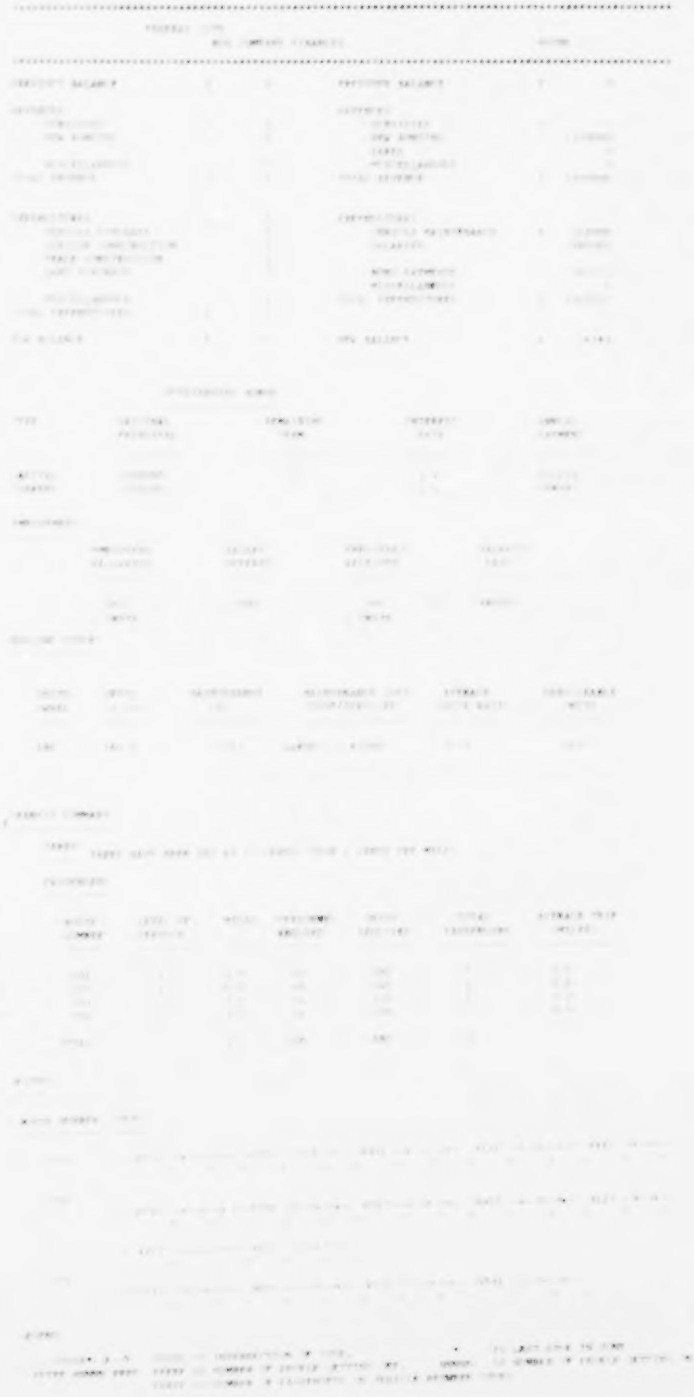
Like the Utility Department, the Bus and Rapid Rail Companies are quasi-private departments and therefore do not receive direct appropriations from the Chairman. Both companies, however, can receive income from any of the following sources.

Subsidies: These are public subsidies granted by the Chairman to the current or capital accounts of either company.

Bonds: Current bonds are automatically floated by the computer if the current expenditures of either company exceed current revenues. Current bonds have a duration of two years and the interest rate is set by the computer. Capital bonds may be floated for either company by the Chairman subject to a referendum by the social sector. Capital bonds have a duration of 25 years and the interest rate is determined by the computer.

Fares: The primary source of income for the Bus Company and Rail Company is the fares which they charge to passengers who use their service. Fares are deducted by the computer from the accounts of population units represented by social decision-makers on the basis of 250 trips to work and 250 trips from work each year (round). The fare charged by the company is for a single worker-trip; the yearly amount is calculated based on two trips per day, five days per week, fifty weeks per year (i.e., single trip fare times 500).

Miscellaneous: These revenues include such items as cash transfers to the capital or current accounts of either company and income from the sale of land (capital account of Rail Company only).



Expenditures

The Bus and the Rail Companies spend money on the following items:

Vehicle maintenance: This includes the cost of maintenance and renovation costs of vehicles owned by the companies. It involves purchases of goods and services at fixed prices from the Outside System (i.e., the computer).

Salaries: Since both companies hire middle income (PM) workers, they must offer competitive salaries.

Bond payments: These include payments on interest and principal of any outstanding capital or current bonds floated by either company.

Miscellaneous: These expenditures include cash transfers from the capital or current accounts of the company to an economic or social or governmental decision-maker, or from one account to another account.

Vehicle purchase: This is a capital expenditure for the purchase of rolling stock. One unit of equipment (either bus or rail) has a fixed cost of $10,000. If any stock is sold, this item will subtract the selling price of stock and may indicate a negative number which will be credited to the capital account of the company. The selling price of a unit of equipment is defined as: .50 times value ratio of equipment/100 times the original purchase cost of a unit of equipment.

Station Construction: (Rail Company only). This includes expenditures for building stations.

Track construction: (Rail Company only). This includes expenditures for the construction of rail tracks. The cost of diagonal tracks is a function of the hypotenuse of the triangle formed by the rail segment. This relationship is explained below:

Distance for diagonal rapid rail segments:

Horizontal distance between stations

		1	2	3	4	5
	1	1.414	2.236	3.162	4.123	5.090
Vertical	2	2.236	2.828	3.606	4.472	5.385
distance	3	3.162	3.606	4.243	5.000	5.831
between	4	4.123	4.472	5.000	5.657	6.403
stations	5	5.099	5.385	5.831	6.403	7.071

Land purchase: (Rail Company only). This item includes expenditures for land purchased from the governmental or economic sectors or from the Outside system (i.e., the computer).

Employment

As the Bus and Rail Companies hire employees (PM's) in groups of 160 workers, it is in the companies' interest to keep the total combination of service level and route lengths such that "Personnel Required" is equal to or slightly below a multiple of 160. For example, if 328 personnel are required, three PM's would be requested and paid for although only slightly more than 2 PM's would be utilized. Personnel requirements can be calculated using route miles and level of service.

Rolling stock

Units owned is the total number of equipment units owned by the company; purchase or sales of equipment are shown here.

Units in use is equal to the units required up to a maximum of Units Owned; Units in Use is the number of equipment units which undergo depreciation.

Serviceable units is Units Owned times the Average Value Ratio/100.

One of the considerations entering into the passenger capacity of a route is the "effective" number of units/mile operating on that route (employment and level of service are the other considerations). Each mile of "level one" route has a requirement of 40 equipment units for full capacity. The total requirement for the system is summed under *Units required*. The actual number of units used is the lesser of *Units in use* or *Serviceable units*. For example, if the units required is 400 and there are only 200 serviceable units, then the passenger capacity is half of the desired capacity of the system.

Passengers

The number under *Total passengers* includes transfers from one route to another which is done at no cost. Therefore, they are not all full paying passengers on that route. Passengers who transfer between modes pay costs for each mode. That is, a worker who drove to a bus station, took a bus to a rail station, and took the rail to his place of employment would pay an auto cost and separate fares to the Bus and Rail Companies.

In order to economically carry passengers, Bus and Rail routes must take PI's from where they live (or from where they can economically drive) to where they work. Thus, it is important both that the routes have stops (or stations) in many residential locations (and in higher residential density locations) and that the routes provide access to a number of work locations. It would be very uneconomical to have a long winding route through low density residences terminating near only one or two employment locations. (Typical cost/mile and break-even fares are noted in the Master Tables, page). As mentioned in the Players' Manual, the routes are directional and are specified to carry workers from residences to their employment location; if a route is specified A → B → C → D, the route would not carry passengers from C to B. A new route C → B would have to be specified.

Routes

This portion of the output indicates, by route, where the bus or rail stops, how many passengers got off at that stop, how many got on, and how many passengers are riding between stops. This information indicates what portions of a route are underutilized and which are overcrowded and thus should affect decisions involving extending, deleting, or upgrading a particular route. The figure for total passengers under the transit summary is the sum of all passengers riding the given route, not their distribution; i.e., a route (level 1) may have 9,000 total passengers, but yet be distributed in such a manner that no segment of the route is overcrowded. Data on which segments are overcrowded would come from the [illegible] output. If a route is highly overcrowded in one round, the computer will probably assign a much lower ridership the following round.

Additional information for each PI on where they live, where they work, and mode, route and cost of transportation is given in the employment [illegible].

```
            STOPS
ROUTE

NUMBER
---------- -----
   101     8531 --->--->--->--  8731 --->--->--->--  8931 --->--->--->--  9131 --->--->--->--  9331 --->--->--->
             0 1360 1360 1080     0  280      0 2840 3120  920  160 2360  160  760 2960

         *  9531
         2960    0    0
   102     8731 --->--->--->--  8729 --->--->--->--  8727 --->--->--->--  8927 --->--->--->--  9127 --->--->--->
             0 1800 1800     0 3290 5090      0  360 5900     0 1720 7120 2000  320 5440

         *  9327 --->--->--->--  9527 --->--->--->--  9727 --->--->--->--  9927 --->--->--->-- 10127 --->--->--->
         1680    0 3760  600  200 3360 3360     0    0     0    0    0     0    0    0

         * 10327 --->--->--->-- 10527 --->--->--->-- 10727 --->--->--->-- 10927
             0    0    0     0    0    0     0    0    0     0    0    0
   104     9137 --->--->--->--  9337 --->--->--->--  9537 --->--->--->--  9535 --->--->--->--  9533 --->--->--->
             0    0    0     0  120  120      0  120  240     0    0  240  120 1920 2040

         *  9531
         2040    0    0
   105     9531 --->--->--->--  9731 --->--->--->--  9931 --->--->--->-- 10131 --->--->--->-- 10331 --->--->--->
             0 4120 4120 1440     0 2680      0    0 2680     0    0 2680     0  680 3360

         * 10531 --->--->--->-- 10731 --->--->--->-- 10931 --->--->--->-- 10929 --->--->--->-- 10927 --->--->--->
         2720    0  640     0    0  640  640     0    0     0    0    0     0    0    0

         * 10727 --->--->--->-- 10527 --->--->--->-- 10327 --->--->--->-- 10127 --->--->--->-- 10125 --->--->--->
             0    0    0     0    0    0     0    0    0     0    0    0     0    0    0

         * 10123 --->--->--->--  9923 --->--->--->--  9723 --->--->--->--  9523 --->--->--->--  9521
             0    0    0     0    0    0     0 1200 1200     0  800 2000  2000    0    0
   106    10127 --->--->--->--  9927 --->--->--->--  9727 --->--->--->--  9527 --->--->--->--  9525 --->--->--->
             0  880  880   400 1120 1520   960    0  560   560    0    0     0    0    0

         *  9523 --->--->--->--  9521
             0    0    0     0    0    0

LEGEND:

** SSSSS*--->--->--->           SSSSS   IS INTERSECTION OF STOP,
FFFFF NNNNN PPPPP               FFFFF   IS NUMBER OF PEOPLE GETTING OFF,
                                PPPPP   IS NUMBER OF PASSENGERS ON VEHICLE BETWEEN STOPS

                                  *     IF LAST STOP IN ZONE
                                NNNNN   IS NUMBER OF PEOPLE GETTING ON
```

Summary of Bus and Rail company decisions

The decisions which the Bus and Rail companies can make fall into three categories: (1) those which are board-wide and can be made by both companies; (2) those which are location-specific and can be made by both companies; and (3) those which are location-specific and can be made by the Rail Company only.

Bus and Rail boardwide decisions:

- Transfer cash
- Purchase or sell rolling stock
- Change fares
- Change salaries
- Change equipment maintenance level

Bus and rail location-specific decisions

- Change routes or levels of service

Rail company location-specific decisions

- Buy and sell land
- Build rail lines
- Build rail stations

The companies can make as many of these decisions as they wish. They can also choose to make no decisions. If no decisions are made, fares, salaries, maintenance, routes, and equipment remain at the previous round's levels. There are no new capital expenditures.

Input format

Bus and Rail company decision makers use a standardized input form when making decisions that must be processed by the computer. The standard message format is:

$CODE/=dm/a, b, c, d, ...

$CODE stands for the type of decision code. The Bus and Rail Companies have the option to make decisions that use the following decision codes:

$ROUT (change routes and levels of service)
$CASH (transfer cash)
$OTHER (buy and sell rolling stock, change fares, salaries, and maintenance level)
$FU (Rail only -- buy or sell land)
$RAIL (Rail only -- construct rail lines and stations)

"*=dm*" is the decision-maker, which for the Bus Company is [illegible] and for the Rail Company is *RAIL*.

The columns "*a*", "*b*", and so forth are filled in with the appropriate information depending upon the particular decision.

Note that there is a slash (/) after the decision code and after the decision-maker code. There are commas separating all other bits of information. Note also that the decision-maker code is prefaced by an equals sign (=).

INPUT FORM

Note: When filling out this form, refer to input description form in the manual.

Please write clearly; distinguish between 1 (one) and "I" (eye), "O" (oh) and "0" (zero); be sure to fill in numbers exactly as required omitting commas within numbers (100000).

RIVER
BASIN
MODEL

Decision Code	Decision-Maker	a	b	c	d	e	f	g	h	i	j	k
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______
$______ /	=______ /	______,	______,	______,	______,	______,	______,	______,	______,	______,	______,	______

Bus and Rail Companies: Input Explanation Form

Type of Decision	Code	Decision-maker	a	b	c	d	e	f	g
Change routes or level of service	$ROUT	BUS or RAIL	Route No.	Old level of service	New level of service (0 if eliminating route)	list, in parentheses, of intersections in order, where route starts, turns, and finishes (0 if no changes to route location)	0		
Transfer cash	$CASH	BUS or RAIL	C	receiver (economic or social decision-maker or department and jurisdiction)	amount (in dollars)	from CAPital or CURrent account	if economic decision-maker receiving, PVT; if social receiving, class receiving (H, M, or L); if department receiving, to CAPital or CURrent account	0	if social receiving, location receiving
Purchase rolling stock	$OTHER	BUS or RAIL	PC	number of units of equipment					
Sell rolling stock	$OTHER	BUS or RAIL	SS	number of units of equipment					

Type of decision	Code	Decision-maker	a	b	c	d
Change fares	$OTHER	BUS or RAIL	P	new fare per worker, per journey (in ¢)	0	price per mile (in ¢)
Change salaries	$OTHER	BUS or RAIL	S	new salary to PM worker (specified as salary per worker in $100's)		
Change maintenance level	$OTHER	BUS or RAIL	M	new maintenance level		

Rail Company: Input Explanation Form

Type of decision	Code	Decision-maker	a	b	c	d
Purchase or bid on land	$PU	RAIL	location	price (in $1000's)	seller (economic decision-maker or department and jurisdiction or GU)	percent of parcel (0 if all)
Build rail lines	$RAIL	RAIL	list of two intersections separated by commas	list of parcels in parentheses from which land is required if line is above ground; if subway, leave blank.		
Build stations	$RAIL	RAIL	location of station			

Sample Bus and Rail company decisions

Bus and Rail boardwide decisions.

Transfer funds: Case 1: The Bus Company transfers $4,000,000 from its current to its capital account.

Decision Code Decision-Maker a b c d e f g

$ØTHER is not used here; $CASH / -BUS / C, BUS, 4000000, CUR, CAP, ____, ____,

Case 2: The Rail Company gives $500,000 from its current account to economic decision-maker E.

$CASH / -RAIL / C, E, 500000, CUR, PVT, ____,

Purchase or sell rolling stock: Case 1: The Bus Company buys 30 units of equipment.

$ØTHER / -BUS / PS, 30, ____, ____,

Case 2: The Rail Company sells 25 units of its equipment.

$ØTHER / -RAIL / SS, 25, ____, ____,

Change fares: The Rail Company sets a base fare of 15 cents plus three cents per mile travelled.

$ØTHER / -RAIL / P, 15, 0, 3, ____,

Change salaries: The Bus Company offers a salary of $540 per month to its workers.

$ØTHER / -BUS / S, 54, ____, ____

Change equipment maintenance levels: The Bus Company [illegible] maintenance level of its equipment to a value ratio of 90.

$ØTHER / -BUS / M, 90, ____, ____.

Rail Company location-specific decisions

Buy or sell land: Case 1: The Rail Company purchases 4% of 88-42 from its economic sector owner, team B, for $18,000.

$ PU / - RAIL / 8842, 18, B, 4, ____,

Case 2: The Rail Company later decided to build underground track at that location and sold the land back to team B for half of what it had originally paid. (Note: the buyer of land is the decision-maker.)

$ PU / - B / 8842, 9, RAIL, 4, ____,

Build rail lines: The Rail Company constructs a rail line from 113-27 to 109-35, and the section across 110-34 and 110-32 is to be above ground.

$ RAIL / - RAIL / 11327, 10935 (11034, 11032), ____,

Build rail stations: The Rail Company builds rail stations at the intersections through which the new track passes (113-27, 111-31, and 109-35).

$ RAIL / - RAIL / 11327/11131/10935, ____,

Bus and Rail location-specific decisions

Change routes or level of service: Case 1: The Bus Company increases the level of service on route 102 from 1 to 3 without changing the route location.

$ ROUT / - BUS / 102, 1, 3, ____,

Case 2: The Bus Company creates a new route along the highway going from 99-33 to 105-33, turning at 105-33 and going to 105-39. The new route has a level of service of 2 and the new route number is 108.

$ ROUT / - BUS / 108, 0, 2, (9933, 10533, 10539), ____,

Case 3: The Rail Company has a route number 204 at a level 2 service going directly from a station at 99-33 to a station at 95-37 and from there to a station at 89-37. The Company wants to modify that route to include its new station at 91-37 (the track already ran between the two stations.)

$ ROUT / - RAIL / 204, 2, 2, (9933, 9537, 9137, 8937).

Note: 1) Bus routes must follow road links. 2) Routes are one-directional, i.e., a single route does not serve travellers going in opposite directions. Thus, the order in which a route is specified determines its direction. The first intersection specified is its beginning and the last is its end.

MASTER SHEET FOR BUS COMPANY AND RAIL COMPANY

General Characteristics

Characteristics	BUS	RAIL
Land Development		
Typical Development costs		
Underground tracks		$14,000,000/mi.
Surface tracks		4,000,000/mi.
Stations		1,000,000
Land requirements		4% surface tracks (for one side only)
Operating Expenses		
Fixed cost of equipment per mile	$400,000 (40 units)	$800,000 (80 Units)
Employment		
Typical cost of labor per mile	40,000	40,000
Units of labor required per mile	50	50
Depreciation and maintenance of equipment		
Average rate (annual)	3.5%	3.5%
BG and BS requirements for 1% renovation or maintenance		
BG	$40/unit of equipment	$40/unit of equipment
BS	$60/unit of equipment	$60/unit of equipment
Passenger Capacity (people)		
When value ratio = 100		
Level 1 Route	3000	6000
Level 2 Route	6000	12000
Level 3 Route	9000	18000

Distance for Diagonal Rapid Rail Segments

Horizontal Distance Between Stations

		1	2	3	4	5
Vertical distance between stations	1	1.414	2.236	3.162	4.123	5.099
	2	2.236	2.828	3.606	4.472	5.385
	3	3.162	3.606	4.243	5.000	5.831
	4	4.123	4.472	5.000	5.657	6.403
	5	5.099	5.385	5.831	6.403	7.071

(NOTE: Bus and Rail hire middle income (PM) workers only. There are 160 workers in a PM. The typical salary per worker is $5,000. One PM supplies 1000 units of labor and 50 units of labor are required to operate a bus (level 1) and rail (level 1) for one mile.)

APPENDIX: EDIT ERROR MESSAGES

The EDIT program processes decisions one at a time in the order in which they are submitted to it by the director. The program checks the data submitted to it for two kinds of errors: coding (incorrect format for a decision or keypunch errors) and legality (violation of a rule of the model, such as construction without utilities or sale of land belonging to another decision-maker). When an error message is printed, the decision to which it applies has been rejected, with a few exceptions which are noted in the explanation of the error messages. In all cases, if a decision does not receive an error message, the program has accepted and processed the decision.

GENERAL ERROR MESSAGES

For all general errors, an indicator (^) points to the approximate location of the error.

1. INVALID $ ENTRY
Incorrect general decision code. All subsequent decisions using this $ entry will be invalidated.

2. INVALID TEAM ENTRY
There is a mistake in the team identification in the decision-maker location of the input card. Might be caused by omitting second slash or mispunching "=".

3. NO CURRENT VALID $ ENTRY
No valid general decision code has been entered or the last one entered is in error. This usually occurs after a #1 error.

4. NO CURRENT VALID TEAM ENTRY
No valid team identification has been entered in the decision-maker location of the input card or the last one entered is in error.

5. NO RIGHT PARENTHESIS
The right hand parenthesis for an input requiring one has been omitted. All lists, and only lists, must be enclosed in parenthesis.

6. NO LEFT PARENTHESIS
The left hand parenthesis for an input requiring one has been omitted.

7. INVALID LOCATION LIST
A list containted a mixture of parcel (even-even), intersection (odd-odd) and road locations (even-odd or odd-even).

8. INCORRECT PUNCTUATION
The indicator points to the incorrect punctuation. Examples: comma (,), slash (/), etc.

9. INVALID LAND USE
A wrong two-letter abbreviation for a land use was used.

10. INVALID TEAM
A team identification (in a position other than where decision-maker is specified) is not a valid team name.

11. MORE THAN 15 CHARACTERS
More than 15 digits fall between two successive commas. This might result if commas were omitted from the input card.

12. NUMBER TOO HIGH
Too large of a number has been input. Check the input explanation form to see if scaling has been observed.

13. NUMBER TOO HIGH OR TOO LOW
The entered number is not within the prescribed limits of this particular entry.

14. INVALID CHARACTER IN NUMBER
An extraneous character has been added to a number. This could be a dollar sign for a land bid or price. Note that all figures are coded without commas.

15. LIST NOT PERMITTED
Parenthesis have been used to include several entries where only one entry is allowed.

16. INCORRECT LOCATION ENTRY
The decision contains something other than a location on the board in a position which should contain a location.

17. BLOCK ENTRY NOT PERMITTED
Opposite corners have been used to specify a zone when a zone is not permitted. Another way to put it is that in this list the character ">" is invalid.

18. INVALID ROAD COORDINATES
The program accepts only even-odd or odd-even combinations that are on the board.

19. MORE THAN 65 LOCATIONS IN LIST
When block input is used, a maximum of 65 parcels can be specified between the parenthesis.

SASMNT

1. SOMEONE [illegible] IS TRYING TO ENTER ASSESSMENT INPUT
A decision-maker other than AS has input a decision using this code.

2. INVALID ENTRY
A road or intersection was specified. Assessment locations must be parcels.

3. NO PARCEL LIST FOR ASSESSMENT
A location has not been specified in column "C" for a type of assessment decision which requires a location (AD, AL, SL, SD).

4. [illegible] IS IN [illegible]
The decision-maker has attempted to assess a parcel which is in another jurisdiction.

5. UNNECESSARY PARCEL LIST FOR ASSESSMENT
A location has been specified in column "C" for a jurisdiction-wide decision setting the assessment ratio of a land use.

6. [illegible] IS NOT A RECOGNIZABLE CONTROL WORD
An incorrect letter code has been used.

7. __________ IS NOT A FARM PARCEL
A farm assessment has been input for a parcel which is not a farm.

$BUILD - $OUBLD

1. (team) CAN'T BUILD (land use)
A decision-maker has attempted to build a type of land use not allowed him.

2. OU PRICE NON-NEGOTIABLE
A price has been entered in a $OUBLD input.

3. _______ IS NOT A JURISDICTION
The jurisdiction number input by a government department is not valid.

4. (location) UNASSIGNED
The indicated parcel is not assigned to a utility district. This message prints if there is a construction on a parcel which was loaded with utilities but not assigned to a utility district.

5. (team) OWNS (location)
The decision-maker specified on the decision input as owning a location does not actually own that parcel.

6. (location) IS UNDEVELOPED
A non-zero old level has been input for a parcel which is undeveloped.

7. (location) IS A FARM OWNED BY (team)
The input specified a construction on a farm parcel.

8. (location) IS NOT A (land use), IT IS A (land use)
A land use has been input with a previous level, but the parcel is not developed in that land use.

9. THERE'S NO (land use) AT (location)
The input specifies an existing land use on a parcel but the parcel does not contain that land use.

10. (land use) AT (location) IS LEVEL __________
The old level of development input does not equal land use's actual level.

11. _____% IS REQUIRED ON (location) - ONLY _____% IS AVAILABLE
The team does not own sufficient land on the parcel for the intended construction.

12. JURISDICTION _____ IS RESPONSIBLE FOR (location)
A road or terminal construction decision has been input by a jurisdiction which does not control that location.

13. (location) IS IN (jurisdiction number)
The parcel is not in the jurisdiction of the decision-maker.

14. LEVEL ERROR
Old and new levels are identical.

15. QI ERROR
The quality index input is less than 40 or greater than 100.

16. ONLY RA'S CAN HAVE PRIVATE UTILITIES
A land use other than RA has attempted to be constructed using private utilities.

17. LOCATION ERROR
The land use specified cannot be at the designated location. Such would be the case if a road were specified for a parcel or if an economic activity were specified on a road or intersection.

18. COST TO (team) FOR BUILD ON (location) IS $(price) ONLY HAS $(capital balance)
The team constructing does not have enough money to pay for the attempted construction.

19. REQUIRES LEVEL (number) UTILITY SERVICE - ONLY HAS LEVEL (number)
The level of utility service installed on the parcel does not provide as many utility units as are required by the new level of development.

20. EXCEEDS UTILITY PLANT CAPACITY
The number of utility units which the proposed construction requires plus the number of utility units already served by the utility plant which serves the parcel on which the construction is located exceeds the plant's capacity (2400 times the plant's level).

21. REALLOCATION OF SERVICE MUST PRECEDE DEMOLITION
There has been an attempt to demolish a utility plant without first assigning all of the parcels served by that plant to another utility plant.

22. UNITS CONSUMED MUST BE DECREASED TO (number) BEFORE DEMOLITION
There has been an attempt to decrease the level of a utility plant when the plant already serves more than 2400 times its new level.

23. (UT or CI) CAN ONLY BUILD OUTSIDE
There has been an attempt to build a utility plant or a construction industry with the $BUILD input code.

24. JOB EXCEEDS (CI location)'S CAPACITY (number of equipment units required for the construction) / (number of equipment units remaining in the CI's capacity)
The CI does not have enough remaining capacity to perform the construction.

25. (team) HAS AN OUTSTANDING CONTRACT TO BUILD A (land use) AT (location)
A team (contractee) has input a construction contract for a land use and location for which it already has a contract.

26. (location) IS ZONED (zoning code) WHICH PROHIBITS (land use)
The attempted construction violates zoning.

$BYCT

1. E OR S
A letter other than E or S was in column "a".

2. (department) DOES NOT BOYCOTT
A government department appears as the decision-maker. Departments do not boycott.

3. U S OR W
A letter other than U, S, or W appeared in column "c".

4. WORK BOYCOTTS ARE SOCIAL BOYCOTTS
An economic decision-maker tried to input a decision to boycott work. Economic decision-makers can only input shopping boycotts.

5. (location) IS NOT A (LAND USE or CLASS)
A social boycott has been input with a letter in column "b" which is not a class or a land use in column "d" which is not an acceptable land use code.

6. *U IS FOR SYSTEM-WIDE BOYCOTT OF BUS OR RAIL BY SOCIAL CLASS*
A location has been input for a use boycott.

7. *ENTER S OR B FOR STOP OR BEGIN*
A letter other than S or B was used in column "e".

8. *(team) CANNOT BOYCOTT (department)*
A shopping boycott has been input against a department.

9. *(location) IS UNDEVELOPED*
The location boycotted (column "d") is undeveloped.

10. *(location) IS A RESIDENCE*
The location boycotted (column "d") is a residence.

11. *(location) IS A (land use)*
A shopping boycott has been input at a location which is not commercially developed.

12. *(team)'S (class or land use)'S ARE NOT BOYCOTTING (SHOP, WORK, or USE) - (location or department)*
An S in column "e" has indicated that an existing boycott is to be stopped, but the boycott does not exist.

13. *(team)'S (class or land use)'S ARE ALREADY BOYCOTTING (SHOP, WORK or USE) - (location or department)*
An attempt was made to begin a boycott which already exists.

14. *(department) DOES NOT HIRE*
An attempt was made to boycott work at a department that does not hire population units.

$CASH

1. *(code input) IS NOT A VALID CODE*
The letter code in column "a" is not a valid letter code.

2. *AS HAS NO CASH*
The Assessment Department has been designated as a giver or receiver of cash. AS does not have an account.

3. *(FOURTH or FIFTH) ENTRY MUST BE CAP OR CUR*
A cash transfer involving a government department must specify the department's capital or current account. If CAP or CUR is used to designate an economic team's account, the designation is ignored and is assumed by the program to be PVT.

4. *(team: PZ or CH) HAS ONLY A (CAPITAL or CURRENT) ACCOUNT*
Either Chairman or Planning and Zoning has been designated as having an account which it does not in fact have.

5. *ONLY CHAIR MAY USE (code input)*
A team other than the Chairman has used a code other than C in column "a".

6. *(team) DOES NOT RECEIVE APPROPRIATIONS*
Chairman has attempted to grant an appropriation using CP or CR to an economic team, UT, RAIL, or CH.

7. *NOT AN APPROPRIATION - DIFFERENT JURISDICTIONS*
Chairman has attempted to grant an appropriation using CP or CR to a department in another jurisdiction, or BUS or RAIL.

8. *WRONG SUBSIDY*
The Chairman has either used SB in column "a" to subsize UT, BUS, or RAIL or used CURS or CAPS in column "a" to subsize an economic team. CURS and CAPS are used for departments; SB is used for economic teams.

9. *(team) DOES NOT RECEIVE SUBSIDIES*
Only UT, BUS, and RAIL can receive subsidies through CURS or CAPS.

10. *LOCATION ENTRY REQUIRED FOR (social team)'S (class)*
A cash transfer involving a social decision-maker has omitted the residence location of the P1's.

11. *THERE ARE NO (class) P1'S ON (location)*
A cash transfer involving a social decision-maker has specified a parcel on which no P1's of the designated class live.

12. *(social decision-maker) DOES NOT CONTROL (class) ON (location)*
The social decision-maker designated as controlling a class on a parcel does not in fact control those P1's.

13. *(social team)'S class ON (location) ONLY HAVE $ (savings)*
The social decision-maker attempted to transfer an amount greater than the number of P1's times the sum of the savings per P1 and the miscellaneous income per P1. Note that miscellaneous income is negative if the class has transferred more money than it has received.

14. *THERE IS NO (department and jurisdiction)*
The jurisdiction number input for a department exceeds the number of jurisdictions being used in the model.

15. *NULL TRANSACTION*
A decision-maker has attempted to transfer money from an account to the same account. For economic, the giver and receiver would be identical; for government, the giver and receiver would match and both accounts would be capital or current; for social, the giver and receiver would match, the class giving and receiving would match, and the locations would match.

16. *(team) ONLY HAS $(amount)*
A team has less money in its capital account (total capital revenue less capital expenditures) than it is attempting to transfer. Note that there is no check on a transfer from a current account.

$CVPT

1. *(code input) IS NOT A VALID CODE*
A code other than one allowed by $CVPT or $OTHER has been input in column "a".

2. *THERE IS NO UTILITY PLANT ON (location)*
The utility plant location specified in column "c" does not contain a utility plant on a decision to change utility service.

3. *THE PLANT AT (location) IS UNDEVELOPED*
The Utility Department has only undeveloped land at the location specified in column "c" on a decision to change utility service.

4. *(location) IS IN JURISDICTION (number)*
The location designated in column "c" is in a different jurisdiction from the one of the Utility Department which input a decision to change utility service.

5. *(number) IS NOT A VALID UTILITY LEVEL*
The new level of service specified on a decision to change utility service is not a number between 0 and 9

6. LOCATION ERROR

A location other than a parcel has been specified in column "b". The location should be a parcel.

7. (UTILITY or INTAKE or OUTFLOW) PLANT AT (location) CAN'T CHANGE

An attempt has been made to change the utility district in which a parcel containing a utility, inflow, or outflow plant is located. The utility district to which such a parcel is assigned cannot be changed until the appropriate plant(s) has been demolished.

8. (location) USES MORE THAN (number)

The private development on the parcel for which there was an attempt to change the level of utility service requires more utilities than the new level of service would provide.

9. INSTALLATION AT (location) COSTS $(amount) (department) ONLY HAS $(amount)

The Utility Department has insufficient funds in its capital balance to perform the installation of utility services.

10. NON-CONNECTABLE - (location) (location) etc.

Each listed parcel is not contiguous to a parcel having utilities and served by the designated utility plant. Contiguous parcels are the eight parcels surrounding a parcel.

11. TEAM (team name) DOES NOT (input code)

A decision-maker has input a decision type in column "a" which he is not allowed to make.

12. (zoning code input) IS NOT A VALID ZONING CODE

The two-digit zoning code input in column "c" on a decision to change zoning is not one of the zoning codes allowed in the model.

13. (input code) IS TOO (HIGH or LOW)

The value given to a rent (R), salary (S), maintenance level (M), price (P), number of employees (E), public institutional land (PI or RPI), BG-BS contract percent of purchases (C), or preempted land (PLND or RPLND) exceeds the maximum or minimum amount allowed that value.

Function	Input Minimum	Input Maximum
Rent (R)	0	250
Salary (S)	PL 12	50
	PM 25	100
	PH 50	200
Maintenance Level (M)	0	100
Price (Utility)	0	1600
Price (BG-BS)	500	1500
Price (PG-PS)	50	150
Employees (E)	0	6
All others	0	100

Note: all of these limits are overridden if there is a "1" in column "f".

14. (PI, RPI, PLND or RPLN) REQUIRES SPECIFICATION OF PERCENT OF PARCEL

Column "c" did not contain a specification of what percent of the parcel was to be changed.

15. (PI or RPI) COSTS $(amount) - PZ (jurisdiction) ONLY HAS $(amount) IN CAPITAL FUNDS

The Planning and Zoning Department does not have sufficient funds to carry out the transaction involving public institutional land.

16. (location) MAINTENANCE SET TO MAXIMUM -- (maintenance level)

There was an attempt to increase the maintenance level of a residence to more than 20 points above the lowest quality index which the residence ever reached. The program changes the desired maintenance level to the maximum allowed and then accepts the decision. This is one of the few error messages that do not indicate total rejection of a decision.

17. ONLY (number)% OF (location) IS (PI or PLND)

There was an attempt to take more land out of public institutional or preempt use than was actually in that use.

18. (team)'S (BG or BS) AT (location) HAS NO CONTRACT WITH (department)

There was an attempt to cancel a BG or BS contract, but the contract did not exist.

19. USE $OTHER FOR (input code)

The $CVPT code was used when $OTHER should have been used.

20. (team) OWNS (location)

The economic decision-maker specified on the decision input as owning a location does not actually own that location.

21. (location) IS UNDEVELOPED

An economic decision-maker has attempted to change something on a parcel which is undeveloped.

22. (location) IS A (land use) AND DOES NOT (SET PRICES, EMPLOY, SET RENTS, or CONTRACT)

An economic decision-maker has attempted to make a decision which is not allowed for the economic activity type located on that parcel.

23. THERE'S NO (MS, SC or PI) AT (location)

A MS or SC department tried to change a maintenance level or employee request at a parcel on which the department has no constructed facility, or PZ tried to remove public institutional use of parkland from a parcel on which none exists.

24. (number)% IS REQUIRED ON (location) - ONLY _____% IS AVAILABLE

PZ does not have enough parkland at the location to develop or remove the amount of public institutional land (PI or RPI), or there is not enough privately-owned and undeveloped land on the parcel for the director to create or remove preempted land (PLND or RPLND).

25. (location) IS IN (jurisdiction)

The parcel is not in the jurisdiction of the decision-maker.

26. (location) IS A FARM OWNED BY (team)

An economic decision-maker specified not a business or residence parcel but a parcel which is part of a farm. Decisions regarding farms use $ODDS or $PU.

$ENDS

1. *(code input) IS INVALID CODE*
A code other than L, R, W, or P has been input in column "a".

2. *(land use) AT (location) DOES NOT RECYCLE*
The land use at that location is not a basic industry, so it cannot recycle water.

3. *OPERATING LEVEL (number) AT (location) IS TOO HIGH*
An economic decision-maker has attempted to raise the operating level at a business above its constructed level. The operating level cannot be above the constructed level.

4. *(location) IS NOT A LAKE PARCEL*
The director attempted to specify water quality on a parcel which does not contain a lake.

5. *(number) IS INVALID WATER QUALITY*
The specified water quality is not an integer between 1 and 9.

6. *NO WATER ON (location)*
The director attempted to specify a miscellaneous pollution input on a parcel which has no water.

7. *(location) IS UNDEVELOPED*
There was an attempt to set an operating level at a parcel which is undeveloped.

8. *(location) IS RESIDENTIAL*
There was an attempt to set an operating level at a parcel which is developed residentially.

9. *NO VOLUME OF POLLUTION INPUT FOR (location)*
The director specified miscellaneous pollutants to be dumped on a parcel but did not specify a volume of effluent.

10. *(location) IS A FARM OWNED BY (team)*
The location is not a business which can recycle or set an operating level; it is a farm.

11. *(team) OWNS (location)*
The economic decision-maker specified on the input as owning a location does not actually own that parcel.

12. *TOO MANY POLLUTANTS ENTERED FOR (location)*
The director specified miscellaneous pollutants to be dumped on a parcel but listed more than seven pollutant types and one water volume.

$FSA

1. *(team) CANNOT REQUEST FEDERAL-STATE AID*
The decision-maker is a department other than SC or HY, which are the only departments which can request Federal-State aid.

2. *SC MUST INPUT PARCEL COORDINATES TO FSA*
A School Department did not specify the parcel location for which aid was requested.

3. *HY MUST INPUT ROAD COORDINATES TO FSA*
A Highway Department did not specify the road location for which aid was requested.

4. PARCEL AT (location) IS NOT IN JURISDICTION OF (department)
A School Department has requested aid to build on a parcel which is not in its jurisdiction.

5. ROAD AT (location) NOT IN JURISDICTION OF (department)
A Highway Department has requested aid to build at a location which is not in its jurisdiction.

6. (HY or SC) AT (location) IS LEVEL (number)
Aid has been requested for a level of construction that is less than or equal to the existing level of development at the location.

7. LEVEL (number) AID IS AVAILABLE FOR (HY or SC) AT (location)
Aid has already been granted for a development at the location for a level greater than or equal to the requested level.

8. (department) HAS ENTERED (number) REQUESTS
The School or Highway Department has already made the maximum number of FSA requests allowed it in a round. Schools can make 3 requests; Highways can make 5 requests.

9. AID REQUEST OF (department) FOR (location) (GRANTED or DENIED)
This message states whether or not the department's aid request was granted.

$ODDS

1. (number) IS INVALID RIVER BASIN
The code number of the river basin input on a decision to set dam priorities does not match the code number of any river basin on the board.

2. INVALID FLOOD LEVEL IN RIVER BASIN (number)
The director has input a flood level which does not fall between 1 and 100.

3. INVALID FARM CODE NUMBER, (farm code input)
A decision to set a fertilizer level specified a farm code number that does not match that of any farm on the board.

4. INVALID FERTILIZER FACTOR, (number)
The fertilizer level specified is not between 0 and 3.

5. (team) OWNS FARM (number)
The decision-maker does not own the farm having the code number which he specified.

6. (code input) IS INVALID CODE
A letter code other than A, B, C, F, or R appeared in column "a".

$OTHER

1. (code input) IS NOT A VALID CODE
A code other than one allowed by $OTHER or $CVPT has been input in column "a".

2. TEAM (team name) DOES NOT (input code)
A decision-maker has input a decision type in column "a" which he is not allowed to make.

3. $(amount) NEEDED - $(amount) AVAILABLE
The Bus or Rail Company has attempted to purchase rolling stock costing more than its available capital funds.

4. (BUS or RAIL) ONLY HAS (number) UNITS
The Bus or Rail Company has attempted to sell more rolling stock than it owns.

5. USE $CVPT FOR (input code)
The $OTHER code was used when $CVPT should have been used.

6. (team) DOES NOT SET WELFARE
A decision-maker other than a Chairman has input a decision with "W" in column "a". W is for setting welfare payments only.

7. PAYMENT IS TOO HIGH
The Chairman attempted to set the welfare payment higher than the maximum of $10.000 per unemployed worker. The coded input for the payment should be 100 or less.

8. EA IS AN INVALID CODE
A department other than Schools has used the code "EA" in column "a".

9. (PZ or CH) CANNOT FLOAT (2 or 25) YEAR BONDS
Planning and Zoning has attempted to float a 2-year (current) bond or Chairman has attempted to float a 25-year (capital) bond. PZ has only a capital account; Chairman has only a current account.

10. INTEREST RATE IS (number)%
This message merely shows the interest rate set for a bond or loan from the Outside. The transaction is complete; this is not an error message.

11. SCALE BOND IN 10,000'S
If a bond for $900 million or more is input, the program assumes that the dollar amount was incorrectly scaled. The decision is rejected.

12. ONLY 2 OR 25 FOR TERM
A bond or loan was input with a term other than 2 or 25.

13. ILLEGAL DEPARTMENT
A department has attempted to make a decision which is not allowed it.

14. ILLEGAL ROAD TYPE
The road type specified is not 1, 2, or 3.

15. (team) ONLY HAS (amount)
A team has attempted to lend more money than it has available.

16. USE BONDING ROUTINE
Either a department used "LO" in column "a" or an economic team used LO but did not specify a borrower or an interest rate. Bonds and loans from the Outside use "BO" in column "a".

17. SCALE LOAN IN 10,000'S
If a loan for $900 million or more is input, the program assumes that the dollar amount was incorrectly scaled. The decision is rejected.

18. INVEST COSTS $(amount) - (team) ONLY HAS $(amount) IN CAPITAL FUNDS
An economic team has attempted to invest more money in stocks than it has in available cash.

19. (team) ONLY HAS $(amount) IN (SPECULATIVE or CONSERVATIVE) INVESTMENTS
An economic team has attempted to sell more investments than it has.

20. THERE IS A CI AT (location)
The director has attempted to specify NOCI, but there is still at least one CI on the board. All CI's must be demolished before NOCI is accepted by the program.

21. (amount) LOAN EXCEEDS LIMIT OF (amount that can still be borrowed)
TOTAL DEBT LIMIT IS (amount) PRESENT DEBT IS (amount)
The economic team has attempted to borrow more money from the Outside than its debt limit allows. There is no limit on the amount which a team can borrow from another team.

$PU

1. OUTSIDE DOES NOT BUY LAND
"OU" was input on the decision-maker purchasing a parcel of land. The Outside cannot purchase land.

2. (department) CAN'T OWN LAND
CH, AS, or BUS was input as the decision-maker purchasing a parcel of land. Those departments cannot own land.

3. DIFFERENT AREAS
Departments in different jurisdictions attempted to transfer land.

4. ONLY DEPT'S SELL PART TO PVT
A private team attempted to purchase part of a parcel from a private team by specifying a number other than "0" in column "d".

5. (location) COSTS $(amount) - (team) ONLY HAS $(amount)
The buyer does not have enough funds to make the land purchase.

6. (team) OWNS (location)
The private owner of a parcel specified in column "c" is not the parcel's actual private owner.

7. (location) IS IN (jurisdiction)
The parcel is not in the jurisdiction specified on the input.

8. (team) CAN ONLY SELL (amount) ON (location)
A team has attempted to sell more land on a parcel than it has undeveloped there.

9. (team) (amount) BID ON (location) (ACCEPTED or REJECTED) (probability)
(random number)
If the probability is less than the random number, the bid has been accepted. This is not an error message; it reports the outcome of an unsolicited bid on Outside-owned land.

$RAIL

1. TEAM (team name) CANNOT ENTER RAIL INPUT
A team other than RAIL has used the $RAIL code.

2. LIST MUST BE OF PARCELS
The list of parcels over which the track being constructed is on the surface contains a location which is not a parcel.

3. SAME INTERSECTION PAIR TO BUILD RR (location)
On a decision to build a track segment the same intersection was given for the beginning and end points. If a station is to be constructed, only one intersection is specified. If a track is to be constructed, two different intersections are specified.

4. *RAIL SEGMENT FROM (intersection location) TO (intersection location) NOT BUILT*
There is already a track between the designated intersections, so a new one was not put there by the program. There can be only one track directly between two intersections.

5. **** NO RAILROAD LAND ON PARCEL (location)*
The Rail Company does not own any land on a parcel where it has specified that track will be on the surface.

6. **** PARCEL (location) WAS NOT SPECIFIED*
A parcel on which a surface track segment must be located in order to connect the designated intersections was not specified on the input as being a parcel over which a surface track would go. A track segment directly connecting two stations must be either entirely on the surface or entirely underground.

7. *NOT A VALID INTERSECTION OR INTERSECTIONS ARE EQUAL (location)(location)*
At least one of the locations is not an intersection location or the intersections are identical.

8. *RAIL ONLY HAS $(capital balance) - NO STATION BUILT AT (location)*
The Rail Company does not have sufficient funds to construct the designated station.

9. *STATION ALREADY EXISTS AT (location)*
There is already a rail station at the location where a station was to be constructed by the decision input.

$REDIST

1. *LOCATION ERROR*
A road or intersection was specified in column "b" where a list of parcels should appear.

2. *NO PARCEL LIST INCLUDED FOR REDISTRICTING*
Column "b" was blank. A list of parcels to be added to the district should appear there.

3. *TEAM (name) CANNOT REDISTRICT*
A team other than MS or SC tried to use the $REDIST input code.

4. *(location) HAS NO (MS or SC)*
The location specified in column "a" does not have a school or MS on it.

5. *(location) IS IN JURISDICTION (number)*
A school or MS location which is not in the jurisdiction of the decision-maker has been specified in column "a".

6. *PARCEL AT (location) IS NOT IN JURISDICTION OF TEAM (name)*
A parcel which is not in the jurisdiction of the decision-maker has been specified in column "b".

After all decisions have been processed, the program checks that districts consist of contiguous parcels. One of two error messages indicates that redistricting has failed:

1. *PROPOSED REDISTRICTING RESULTS IN DISTRICT FOR (SC or MS) AT (location) BEING DISCONTINUOUS*
The district which was to have been served by the school or MS does not consist of contiguous parcels.

2. *THERE IS NO LONGER A (SC or MS) AT (location)*
A redistricting decision would have added parcels to a district in which the school or MS was demolished.

In either case, the error message is followed by:

(SC or MS) REDISTRICTING FOR JURISDICTION (number) REJECTED

$ROUT

1. *** *BUS OR RAIL NOT SPECIFIED*
A decision-maker other than BUS or RAIL used the $ROUT input code.

2. *** *ROUTE NOT FOUND*
There was an attempt to eliminate a route by specifying a new level of 0 in column "c", but there is no route with the code number specified in column "a".

3. *** *NO INTERSECTIONS SPECIFIED*
A list of intersections where a route is to go (column "d") included either one or no intersections.

4. *** *BUS ROUTES MUST FOLLOW ROADS*
Two successive intersections do not lie along the same row or the same column, i.e., the part of the bus route specified attempts to cross parcels diagonally. Bus routes must follow roads, i.e., the segments must be horizontal or vertical.

5. *NO ROAD (EAST, WEST, NORTH, or SOUTH) FROM (intersection)*
A bus route has been specified as travelling along a roadbed. Bus routes must be along roads.

6. *** *NO TRACK FROM (intersection) TO (intersection)*
A rail route has been specified between two intersections which are not directly connected by a track segment.

7. *** *NO STATION ON (intersection)*
There is no station at a location which has been designated as a rail stop.

$TAXES

1. *(number) EXCEEDS TAX MAXIMUM OF 99*
The maximum tax rate of 9.9% has been exceeded by the decision. The maximum limitation is waived if there is a "1" in column "c".

2. *ONLY CH1, CH2, or CH3 CAN ENTER TAXES*
A decision-maker other than a Chairman has used the $TAXES code.

3. *L, C, RI, EI, RA, EA, G, or S*
A code other than one listed above was used in column "a".

$TIME

1. *ONLY PVT ALLOCATES*
Only a social decision-maker can input a time allocation decision.

2. *ONLY L1, L2, L3, M1, M2, M3, H1, H2, OR H3*
These population unit codes by jurisdiction are the only ones allowed (column "a").

3. *HIGH CAN'T ALLOCATE FREE SCHOOL*
Time for PH has been allocated to free education (column "b").

4. *TIME ADDS TO (total of units if over 100)*
An allocation of more than 100 time units was attempted.

5. *LOCATION ERROR*
If intersection or road segment is input as a location for Pl's.

6. *(team) DOES NOT CONTROL (H, M, or L) ON (location)*
A team has attempted to make time allocation decisions for a class on a parcel over which it does not have control.

7. *THERE ARE NO (H, M, L)'S ON (location)*
Time has been allocated for a class of Pl's on a parcel where no members of that class reside.

8. *(location) IS IN (jurisdiction number)*
If the specified location is not in the jurisdiction indicated by the number after H, M, or L (column "a").

9. *LOW CAN'T ALLOCATE PAY SCHOOL*
Time for PL has been allocated to pay education.

10. *(team) DOES NOT CONTROL POPULATION*
The social decision-maker input on the decision is not a valid social decision-maker as specified when the original data base was loaded.

$VALUE

1. *(team) DOES NOT SET TIME VALUE*
A team other than a social decision-maker has attempted to use the $VALUE code.

2. *L, M, or H*
Column "a" contains a character other than L, M, or H.

$WRBLD

1. *(location input) IS NOT LEGIT LOCATION*
The location input in column "b" is not a parcel location on the board.

2. *(code input) IS INVALID CODE*
The program did not recognize the letter code input in column "a".

3. *(location) IS INVALID DISTRICT PLANT LOCATION*
The parcel specified as having a utility plant does not in fact have a utility plant on it.

4. *(code input) IS INVALID TREATMENT TYPE*
The type of effluent treatment plant input is not CL, PT, ST, or TT.

5. *(code input) IS INVALID I-O CODE*
The code input is not "IN" or "OUT".

6. *(location) HAS NO TREATMENT PLANT*
A Utility Department tried to build a treatment plant in a district which already has a treatment plant of that type (type being intake or outflow). The other treatment plant must be demolished before a plant at a different location in the same utility department can be constructed.

7. NOT ENOUGH LAND AT (location)
The Utility Department does not have enough land for the desired treatment plant construction.

8. (location) IS INVALID (A, P, or M) SAMPLING STATION LOCATION
The type of sampling station input cannot function at the location input. For A, the location must have surface water; for P, the location must have an economic activity; for M, the location must have a municipal outflow point.

9. (team) OWNS (location)
The economic decision-maker input as owning a parcel does not actually own that parcel.

10. BI TREATS OUTFLOW ONLY
There was a decision to build an intake treatment plant at a business. A basic industry can build an outflow plant only.

11. (land use) DOESN'T TREAT EFFLUENT
The economic activity on the parcel is not a basic industry, so it cannot treat its effluent.

12. OLD LEVEL IS NOT (level input)
The old level of treatment plant specified on the decision input does not match the plant's actual level.

13. COST TO (team) FOR WRBLD ON (location) IS $(amount), HAS ONLY $(amount)
The team does not have enough money to perform the construction.

14. TEAM MUST BE UTILITY
A team other than the Utility Department input a decision to locate an intake point, an outflow point, or a sampling station.

15. NO WATER ON (location)
There was an attempt to locate an intake or outflow point on a parcel which is not a lake or does not contain surface water.

$WRPRC

1. TEAM MUST BE UTILITY
A team other than a Utility Department used the $WRPRC code.

2. (land use) DOES NOT USE MUNICIPAL WATER
The land use for which the department attempted to set a price is a surface water user, a government department, or nothing. Prices can be set only for municipal water users.